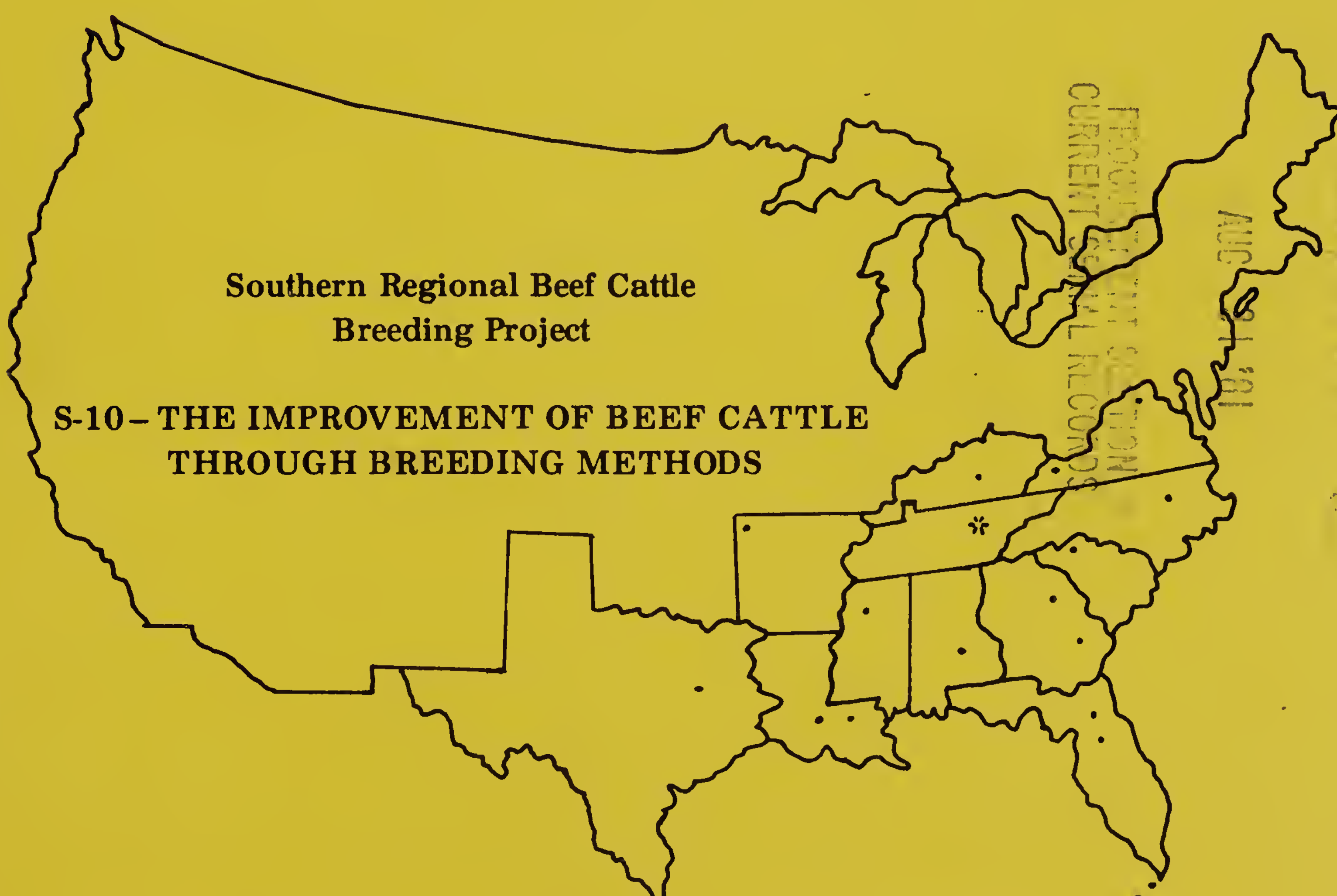
UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
ANIMAL SCIENCE RESEARCH DIVISION
and
COOPERATING SOUTHERN STATES

1969-1970 Annual Report of S-10 and Report of Annual Technical Committee Meeting Hastings, Nebraska August 10-12, 1970



This report is intended for the use of administrative leaders and workers and is not for general publication.

S-10 - 1970 ANNUAL REPORT

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INTRODUCTION

This project was initiated in 1948 to investigate and develop methods of breeding more productive beef cattle for the South. Detailed annual reports showing research developments and progress in each state have been prepared each year since 1950. Complete results of certain phases of the project have been reported in regional bulletins and technical articles and bulletins published by workers in the various states which contribute to the S-10 project.

This publication includes the proceedings of the 1970 annual meeting of the S-10 Technical Committee and the annual reports of projects in each of the twelve contributing states. The annual reports of S-10 contributing and supporting projects were prepared by the project leaders and other personnel at the various stations as summaries of the research developments and progress at each station during 1969. The results are not considered final, but the materials aid cooperators in developing an integrated program. This report also provides information needed by heads of animal husbandry departments, experiment station directors, and U. S. Department of Agriculture officials for evaluation of the projects with respect to objectives and procedures. <u>This report is not for general distribution and material contained in it should not be quoted in publications</u>.

JOINT MEETING
REGIONAL BEEF CATTLE BREEDING TECHNICAL COMMITTEES
NC-1, S-10, WRCC-1

U. S. Meat Animal Research Center
Clay Center, Nebraska

August 10-12, 1970

Monday, August 10

Morning	Chairman--L. V. Cundiff
8:30 a.m.	Welcome--Ralph Hodgson
8:40 a.m.	The Beef Cattle Industry--Nature and Future Research Requirements--Lavon Sumption
9:10 a.m.	Discussion--R. L. Blackwell, Leader
9:45 a.m.	Coffee
10:00 a.m.	Beef Cattle Breeding Research and the Industry It Serves--
	Important biological and economic problems and the scope of beef cattle breeding research required.--L. A. Swiger
	An evaluation of beef cattle breeding research: Are programs "tuned in" on the industry's problems? Do we reflect an adequate sense of urgency? The impact of estrus control, A.I., sexed semen, and other beef cattle breeding technology on germ plasm control and management.--L. N. Hazel
11:00 a.m.	Discussion--James Brinks, Leader
12:00 noon	Lunch
Afternoon	Chairman--Keith Gregory
1:00 p.m.	The U. S. Meat Animal Research Center--Keith Gregory
	Development Status Present Beef Cattle Research Programs Goals
2:00-6:00 p.m.	Tour of U. S. Meat Animal Research Center--Walt Rowden and Hudson Glimp
6:30 p.m.	Refreshments and dinner

Tuesday, August 11

Morning	Chairman--Will Butts
8:30 a.m.	The Role of Research in Characterizing Germ Plasm Resources Identifying optimum adaptability to specific feed, climatic, and production environments. Relationships among fertility and optimum growth curve, mature size, milk production, etc.--T. C. Cartwright
9:00 a.m.	Evaluation of Breed Differences--Gordon Dickerson
9:30 a.m.	Programs to Utilize Breed Differences--Howard Fredeen
10:00 a.m.	Coffee
10:15 a.m.	Discussion--Will Butts, Leader
12:00 noon	Lunch
Afternoon	Chairman--T. C. Byerly
	Meeting Beef Cattle Research Requirements Through Joint Planning and Cooperative Execution
1:00 p.m.	Regional Goals for Cooperation with the U. S. Meat Animal Research Center-- J. W. Turner, Chairman, S-10 Technical Committee R. M. Koch, Chairman, NC-1 Technical Committee Curt Bailey, Chairman, WRCC-1 Technical Committee Response--Keith Gregory
2:45 p.m.	Coffee
3:00 p.m.	Report of the Joint Study Committee on Beef Cattle Research--E. J. Warwick and J. A. Whatley, Jr.
4:00 p.m.	Discussion--T. C. Byerly, Leader
Evening	Chairman--Ralph Hodgson
7:30 p.m.	The Canada Department of Agriculture Germ Plasm Evaluation Research and Import Program--August Johnson
7:50 p.m.	The proposed USDA Cattle Import Program--A Status Report--E. J. Warwick
8:10 p.m.	Texas-Argentina Cooperative Evaluation Programs--T. C. Cartwright
8:30 p.m.	Discussion--Ralph Hodgson, Leader

Wednesday, August 12

Morning	Chairman--Bradford W. Knapp
8:00 a.m.	Administrative Reviews (Analysis and perspective of matters covered by program on August 10 and 11)
	Paul Putnam Estel Cobb Roy Kottman Martin Burris Doyle Chambers
10:00 a.m.	Independent meetings by:
	WRCC-1 NC-1 S-10
	Adjournment

MINUTES OF S-10 EXECUTIVE COMMITTEE MEETING

Memphis, Tennessee
February 1, 1970

The meeting of the S-10 Executive Committee was called to order by J. W. Turner at 5:00 p.m. in the Sheraton-Peabody Hotel. The purpose of the meeting was to discuss the joint meeting between W-1, NC-1, and S-10 planned for August 10, 11, and 12 of 1970 at Clay Center, Nebraska. Those present at the meeting were:

J. W. Turner, Chairman
Will T. Butts, Jr., S-10 Investigations Leader
R. R. Shrode, Secretary
Doyle Chambers, S-10 Administrative Advisor
Fred A. Thrift, Committeeman
L. V. Cundiff, NC-1, Investigations Leader

Larry Cundiff stated that plans for the joint meeting at Clay Center had not been finalized. He suggested that the Research Coordinator and Chairman of the Executive Committee from each Region try to meet at Clay Center sometime in March or April to plan and organize details of the joint meeting. He further stated that a tour of the entire Clay Center facilities would be made at the time of the joint meeting.

Doyle Chambers suggested that rather than just presenting individual station reports, perhaps some topics should be discussed that would interest all personnel present at the joint meeting. Larry Cundiff indicated that some discussion should be directed toward identifying research needs for the 70's in the area of Animal Breeding.

J. W. Turner indicated that in addition to the program planned by Clay Center, S-10 would need at least one-half day to cover station reports and conduct a business meeting.

Some discussion was had concerning up-dating of Regional publications. J. W. Turner stated that Marvin Koger and Tom Cartwright were appointed to review the crossbreeding work conducted in the S-10 Region, and Troy Patterson and C. J. Brown were appointed to review work concerning breed differences. Doyle Chambers suggested that it would be desirable if the planned Regional publications were prepared before the overall S-10 project is reviewed by the Committee of Nine.

There being no further business or discussion, the meeting was adjourned by Chairman Turner.

Respectfully submitted,

F. A. Thrift

MINUTES OF S-10 TECHNICAL COMMITTEE MEETING

Hastings, Nebraska
August 10-12, 1970

All representatives from the Southern Region attended the joint sessions of NC-1, WRCC-1 and S-10 hosted by the United States Meat Animal Research Center. Papers presented at these sessions are included in the S-10 annual report.

The business session of the S-10 Technical Committee was convened by Chairman J. W. Turner at 9:05 a.m., on August 12, in the Green Room of the Clarke Hotel. The following Technical Committee Representatives were present:

Alabama - T. B. Patterson, Auburn University, Auburn
Arkansas - C. J. Brown, University of Arkansas, Fayetteville
Florida - M. Koger, University of Florida, Gainesville
Georgia - W. C. McCormick, Georgia Coastal Plains Experiment Sta., Tifton
Kentucky - Fred Thrift, University of Kentucky, Lexington
Louisiana - J. W. Turner, Louisiana State University, Baton Rouge
Mississippi - Fay Hagan, Mississippi State University, State College
North Carolina - E. U. Dillard, North Carolina State University, Raleigh
South Carolina - J. R. Hill, Jr., Clemson University, Clemson
Tennessee - R. R. Shrode, University of Tennessee, Knoxville
Texas - T. C. Cartwright, Texas A&M University, College Station
Virginia - J. A. Gaines, Virginia Polytechnic Institute, Blacksburg

Other agencies and leaders:

Administrative advisor - Doyle Chambers, L. S. U., Baton Rouge
AHRD - USDA - E. J. Warwick, USDA, Beltsville, Maryland
AHRD - USDA - Paul Putnam, USDA, Beltsville, Maryland
ARS - USDA - Ruel Wilson, Bimetrical Services ARS, USDA, Beltsville, Md.
Investigations Leader - Will T. Butts, Jr., AHRD, U. of Tenn., Knoxville

Others in attendance were:

K. P. Bovard, Virginia Polytechnic Institute, Front Royal
R. F. Boulware, Louisiana State University, Baton Rouge
W. C. Burns, Brooksville Beef Cattle Research Station, Brooksville, Fla.
Hollis Chapman, Georgia Coastal Plains Experiment Station, Tifton
T. M. Clyburn, Georgia Coastal Plains Experiment Station, Reidsville
J. R. Crockett, University of Florida, Belle Glade
T. M. DeRouen, Iberia Livestock Research Station, Jeanerette, Louisiana
S. H. Fowler, Mississippi State University, State College
D. E. Franke, University of Florida, Gainesville
H. A. Glimp, U. S. Meat Animal Research Center, Clay Center, Nebraska
P. E. Humes, Louisiana State University, Baton Rouge
Richard McDonald, Louisiana State University, Baton Rouge
J. C. Scarsi, Virginia Polytechnic Institute, Blacksburg
R. D. Scarth, University of Georgia, Athens

Chairman Turner instructed the secretary to write letters to Keith Gregory, Larry Cundiff, Hudson Glimp, and Walter Rowden expressing our appreciation for the excellent work they did in hosting the joint meeting and planning the worthwhile program.

Investigations Leader Butts presented his tentative 5-year summary of accomplishments in the S-10 project, copies of which had previously been distributed. Procedures with respect to the summary were briefly discussed. Dr. Koger suggested that the bulk of the responsibility for preparing and submitting the summary be delegated to Dr. Butts and Dr. Chambers because of their familiarity with what is desired in the way of format, etc.

It was moved and seconded by Dr. McCormick and Dr. Brown, respectively, that the project statement with brief comments on changes in individual state projects be submitted along with the 5-year summary. Dr. Chambers voiced his belief that this would be satisfactory. The motion carried.

Dr. Butts requested that each project leader submit to him by September 15, a 5-year summary of progress in his project and any proposed rewriting of his portion of the regional project statement.

Brief discussion of the regional objectives concluded with agreement that no change in their wording is needed.

Chairman Turner called on Dr. Chambers for comments on the joint meeting just concluded and on cooperative work with USMARC. Dr. Chambers spoke briefly, indicating that he foresees no serious problems in connection with such cooperative work, but that it might necessitate finding additional state funds or Hatch money since all current regional money is probably already locally committed.

Dr. Butts discussed briefly the new Florida and Tennessee projects, copies of which have been circulated to technical committee members. It was pointed out that both of these are actually Beef Cattle Branch projects, and the Tennessee project is also a state project.

It was moved and seconded by Dr. Thrift and Dr. Brown, respectively, that the technical committee go on record as approving both projects. The motion carried.

Dr. Patterson was elected as the new member of the executive committee. Thus, the executive committee for the coming year will be:

R. R. Shrode - Chairman
Fred Thrift - Secretary
T. B. Patterson

Dr. Turner relinquished the chair to Dr. Shrode and extended an invitation to hold the 1971 meeting in Louisiana in early June.

It was moved and seconded by Dr. Patterson and Dr. Dillard, respectively, that the invitation be accepted. The motion carried.

The meeting was adjourned at 11:50 a.m.

Respectfully submitted,

R. R. Shrode, Secretary

1970 REPORT TO REGIONAL TECHNICAL COMMITTEES

Estel H. Cobb - CSRS

Changes in CSRS Personnel

On June 30, 1970, Dr. H. C. Knoblauch retired after 35 years of Federal service, 30 of them being in CSRS. He has been associate administrator for the past several years. Trained as a soils scientist, Dr. Knoblauch has had a distinguished career of services to science and agriculture.

Revision of Manual of Procedures

CSRS-OD-1082, Manual of Procedures for Cooperative Regional Research, was revised, effective January 1970. Copies have been sent to all station directors. If anyone needs additional copies, please let me know.

Summary of Status of Fiscal 1971 Appropriations (H.R. 17923) As of June 29, 1970

	Appropr. 1970	President's '71 Budget	House Bill 6/4/70	Senate Report 6/29/70
Hatch				
Payments to States	$53,756,941	$62,399,641	$56,861,911	$59,771,911
Administration	1,432,059	1,699,359	1,528,089	1,618,089
Total	55,189,000	64,099,000	58,390,000	61,390,000 1/
McIntire-Stennis	3,785,000	4,412,000	4,012,000	4,412,000
Facilities	1,000,000	-0-	-0-	-0-
Contracts and grants	2,000,000	3,350,000	2,000,000	3,350,000
Penalty mail	160,000	160,000	160,000	160,000
Federal Admin.-other	376,000	514,000	514,000	514,000
Total CSRS	$62,510,000	$72,535,000	$65,076,000	$69,826,000

1/ Includes $3,201,000 for increased cost of conducting research and $3 million for Community Improvement Research.

Joint committee of House and Senate is now working on final version.

International Quarantine Station

Public law 91-239 was approved on May 6, 1970. The purpose of the act is to provide for the establishment of an international quarantine station and to permit the entry therein of animals from any country and the subsequent movement of such animals into other parts of the United States for purposes of improving livestock breeds, and for other purposes (formerly S. 2306).

Changes in Regional Research Projects Related to Genetics and Animal Breeding

The Western regional beef cattle breeding project (W-1) was terminated, effective June 30, 1970. A Western Regional Coordinating Committee for Beef Cattle Breeding Research (WRCC-1) has been authorized by the Western Directors for a three-year period starting July 1, 1970, with Martin J. Burris (Montana) as administrative advisor.

A new Western regional research project entitled "Reproductive Performance in Beef Cattle (W-112)" was initiated July 1, 1970. Rue Jensen (Colorado) is administrative advisor.

A new Northeastern regional research project entitled "Control of Reproduction in the Bovine Female (NE-72)" has been approved with R. J. Flipse (Pennsylvania) as administrative advisor.

S-10 REGIONAL GOALS FOR COOPERATION WITH THE U. S. MEAT ANIMAL RESEARCH CENTER

J. W. Turner

Defining regional goals for cooperative research with the U. S. Meat Animal Research Center (MARC) would, at first, appear to be a simple task. All research efforts are aimed at common goals of increased production at reduced costs by accumulating knowledge. Cooperative effort implies effective communication and organization of complementary projects to insure an organized, integrated research effort of mutual benefit. However, regional goals must necessarily be identified with individual station projects since the regional effort is cooperative.

Cooperative efforts of S-10 contributing stations with the MARC might best be characterized by defining mutual benefit. The MARC possesses facilities and supporting personnel that cannot be duplicated at any individual station. As a research facility, undivided attention to research planning, execution and analysis is assured. However, there are lingering questions relative to genotype x environment interactions and specific management techniques dictated by environmental conditions that detract from a strong, centralized facility effectively contributing material benefit on an applied basis. Therefore, it would appear that particular cooperation should be developed in the choice of research problems conducted by the various stations. Certainly major attention at the MARC should be directed to basic work and each localized station should consider more applied problems.

With reference to existing projects, the MARC can possibly supply valuable assistance. Specifically, the MARC might ably assist in feedlot and carcass evaluation of progeny from cooperative projects. The South is not noted for its feedlot industry and most individual stations do not possess facilities to feed and evaluate any sizeable number of progeny. Realizing that the beef industry is segmented, the MARC might benefit by accumulating large samples of cattle for feeding studies that would parallel feedlot industry situations.

Opportunities certainly exist for exchange of experimental animals to evaluate genotype x environment interactions. It is most important that such interactions be investigated for selection decisions. Such exchange will allow the MARC to accumulate samples from many herds for determining herd differences.

Paramount to the establishment or execution of cooperative efforts, close personal communication of principles must be insured. Cooperative agreements often yield no results due to the lack of communication. Therefore, individual project leaders stationed at the MARC and with each cooperative station will supply the impetus for a true cooperative effort. Administrative assignment alone will not suffice to direct cooperative research.

It would appear that a precise definition of cooperation is required to relate to needed goals. Webster's Seventh New Collegiate Dictionary presented three definitions. The first, reads "the act or process of cooperating". This is of no value since cooperation is defined with itself. The second definition reads, "association of persons for common benefit". While this has merit for this group it does not directly relate. Therefore, the third definition must surely relate. It reads, "a dynamic ecological state of organisms living in aggregation characterized

by sufficient mutual benefit to outweigh disadvantages associated with crowding"! Paraphrasing this definition does define our goals. Animal agriculture research is dynamic and the individual research station must identify itself with the research community. State stations and the MARC need open avenues of communication and vital personnel interested in a stronger beef industry.

COOPERATION BETWEEN THE WESTERN REGION AND THE U. S. MEAT ANIMAL RESEARCH CENTER

C. M. Bailey

COOPERATIVE PROGRAMS WITH THE U. S. MEAT ANIMAL RESEARCH CENTER

There has been considerable discussion among animal scientists in the Western States concerning the relation of research activities at State Experiment Stations with programs that are under development at the national research facility at Clay Center. Numerous recommendations have been made for cooperative work programs involving state institutions and the U. S. Meat Animal Research Center. Those that I will refer to here today have been proposed by the members of the W-1 Technical Committee. Each recommendation should be considered within the framework of a total, integrated program contributing to a regional or national goal rather than as a separate entity.

1. First, it is apparent that the U. S. Meat Animal Research Center can have a key role in the training and professional development of animal scientists. As laboratory facilities are completed and as staff positions are filled, graduate students and scientists from other institutions can receive specilized and advanced training at the Center and, under certain circumstances, participate in on-going research projects. Perhaps in the future it will be possible to establish U. S. Meat Animal Research Center Fellowships for pre-doctoral and post-doctoral programs. Provision should also be made for USMARC staff members who wish to study with other research groups.

2. In many instances the interpretation of results from beef cattle breeding studies would be enhanced by the inclusion of control groups to evaluate genetic changes. Consideration should be given to the possibility of establishing a regional control program, utilizing control herds at Clay Center as a standard. Such a program would necessitate the use of artificial insemination and, conceivably, ova transplants could be employed in the future to reconstitute control stocks at different locations as needed.

3. Many outstanding herds of the established breeds have been developed in conjunction with teaching and research programs at state universities. These cattle represent a wide variety of types and bloodlines and could be used efficaciously as source stocks for projects at Clay Center including the germ plasm evaluation study. Benefits to cooperating stations would include an opportunity to obtain useful progeny data and at least in a limited way to compare sires from different breeding groups. A regional or inter-regional genotype x environment interaction study could be incorporated into the overall project.

4. A wide diversity exists in forage resources, disease and climatic conditions, and in economic factors in different parts of the United States. Specifications for breeding stocks and management concepts that are appropriate for one area may be entirely inadequate under other sets of conditions. Consequently, it will be necessary to determine the relative utility of the more promising breeds and breed

combinations in different production areas throughout the country in order to provide recommendations for industry. This will be a task of major proportions that will require concerted action at the national level.

5. The creation of a germ plasm depository at Clay Center would facilitate projects such as those that I have just outlined, thus furnishing needed flexibility in the prosecution of long-term objectives at cooperating stations. Such an installation could also serve as a national reservoir for exotic and/or rare germ plasm.

6. Other areas of cooperation would include laboratory testing services, statistical services, and the exchange of tissues, samples and data.

Some of these suggestions could be implemented at little additional cost, while others would require selective increases in support funds or a shift in research emphasis at some stations. In any event, I think that we all agree that the programs at Clay Center and those conducted at other stations should be coordinated with planning at each stage based on mutual understanding and effective communication so that research capabilities of all agencies can be fully utilized.

This year following the termination of the W-1 Project a new committee was established to coordinate beef cattle breeding studies in the Western Region. Each of the State Experiment Stations was invited to participate. Federal participation includes representatives from the U. S. Range Livestock Experiment Station, Miles City, Montana; the Agricultural Research Service Beef Cattle Investigations Leader's Office, Fort Collins, Colorado and the U. S. Meat Animal Research Center at Clay Center. The Committee, which has been designated WRCC-1, will critically examine the functions of genetics and breeding along with other disciplines in the development of efficient, total production systems for the western cattle industry. The WRCC-1 Committee will also provide liaison at the active research level between Western State Experiment Stations and the U. S. Meat Animal Research Center.

INVITED PAPERS

Joint Meeting Beef Cattle Breeding Research Committees
of the North Central, Southern, and Western Regions
U.S. Meat Animal Research Center
Clay Center, Nebraska
August 10, 1970

WELCOME STATEMENT

R. E. Hodgson, Director
Animal Science Research Division

It is a pleasure for me to welcome each of you to the U.S. Meat Animal Research Center and to wish you every success in your meetings. I believe it is significant that the Committees of the three regions are meeting together at this time and at this place.

A perusal of the program before you suggests that important questions regarding elements of breeding research are to come under intensive examination and review. We are pleased that our colleagues from Canada are here to inform us of their research and related programs.

I note that considerable emphasis is being placed on cooperation in this research and how to more effectively plan, promote, and execute cooperative research across State lines, between Federal and State, and across country borders. This is as it should be. We all are in this work together, we are responsible for use of public funds, we are working for the same interests, and we all stand to gain by working together. There is much to do and enough room for all the scientists we can bring to bear on existing problems, both State and Federal.

We are glad for the opportunity to show you the progress that has been made and the present status of the USMARC. To us progress has been slow only because financing has been slowed, but we are very much on the way. The staff here is dedicated and has made unusual progress under the conditions. The move into the new facility soon to be made will be a milestone of progress. We can now begin staffing our scientists as fast as funds will permit.

I continue to view this Center as an outstanding facility and a needed one to help conduct the required research on meat animals. While it may carry the Federal label, it is here to produce information that is needed and will be useful to the meat animal producers. The program will be a cooperative one to the extent that we all will make it so and it will supplement and complement that which is being done by other institutions working on meat animal research. In this regard it is our intention to make this program truly a part of the total national cooperative program for beef and meat animal research. I anticipate that many of the projects at the Center will be contributing ones to appropriate regional research projects in the different regions.

As you know the beef cattle industry is presently undergoing revolutionary changes, and these changes will continue. This is particularly true of the breeding aspects. Similar changes are needed in other aspects of production. In order to properly guide these changes new information is needed and this information must come from the research laboratories. The challenge to all of us is to

come up with this needed information. The additional challenge is to keep abreast and, insofar as possible, ahead of the game so that the industry can be served effectively.

So welcome and good success in your work.

IMPORTANT BIOLOGICAL AND ECONOMIC PROBLEMS AND THE SCOPE OF BEEF CATTLE BREEDING RESEARCH REQUIRED[1]

L. A. Swiger[2]

I thought the title I was given hinted at the possibility of some different lines of research in beef cattle breeding in the future. Notice the word biology. We also inserted that word in the first objective of the newly written regional swine breeding project. Perhaps our research will become more fundamental in terms of understanding what is happening and why inside the beef animal. I almost said that our research will become more basic, but I am reminded of Herb Kramer, when he was the brand new Director of the Experiment Station at Nebraska, terminating the usual fruitless discussion of classifying research with the following remarks. "There is good and bad applied research. There is good and bad basic research. At Nebraska we are going to do good basic research and good applied research and we won't necessarily know which is which."

Research, including agricultural research, has come to involve so much money that two things have happened which are detrimental. (1) Administration has proliferated beyond reasonable bounds and (2) the political involvement has become too strong an influence. The net result is that the dollar overhead is high, the overhead for the researcher's time is high and decisions on what research will be done has moved away from the research worker. He is planning projects to "capture" funds rather than exercising his wisdom in determining and designing research projects. Using such words as interdisciplinary, multidisciplinary, team, programmed, problem solving, task force as well as pollution, ecology and environment is more important in getting funds than tackling good problems. We will have to make up our minds to fight this battle.

The original dream of USMARC (then referred to as Hastings) as I shared it mostly with Keith Gregory but also Bob Koch and Dr. Baker, was a research organization where some projects would be closely planned, tightly run, team projects. Others would be clearly within a discipline but with free sharing of ideas and suggestions of colleagues of all disciplines. Still others would allow individuals to try their brainstorms relatively unmolested. I hope this persists along with the more idealistic intent of incorporating people and ideas from other stations.

I look on future beef breeding research as a continuation of going after the fundamental facts, such as breed and heterosis effects and parameters for maximizing the efficiency of selection, with considerable more emphasis on unraveling the biology. There is always the chance for that hoped for, but usually not planned for, major breakthrough that is really "big guns" in terms of basic knowledge or application or usually both.

Most of our genetics research is done under one or two management schemes. If we get out answers only in terms of production traits it is difficult to extrapolate

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[1]Talk given August 10, 1970 at the joint meeting of NC-1, S-10, and WRCC-1, USMARC, Clay Center, Nebraska.

[2]Professor of Animal Science, The Ohio State University.

to broader questions. If we understand the basic phenomena of what happened in our experiment, e.g. the in's and out's of energy utilization, we are in a better position to argue questions concerning other management systems or economic conditions. If you make a faulty engine run better simply by kicking it, you start from zero again the next time it goes bad.

We have already learned a lot about selection in beef cattle. We have yet, however, to formulate "net merit" very completely. Of course, there will not be one formulation but several, for the various management schemes and economic systems that do and will exist. Most people overemphasize the instability of economic values. Our industry would be farther ahead to use imperfect selection methods that are the best we can give them rather than use imperfection as an excuse to ignore this tool.

We can surely assign economic values to feed consumption, gain as it reflects the costs associated with time and carcass composition. The value of carcass quality is more difficult becasue of recent and anticipated changes in grading and a lack of knowing real quality traits. Structural soundness is elusive both for its economic value and knowledge of the parameters necessary to incorporate it into a selection index. Breeders handle this trait by absolute culling levels, but what price are we paying in an overall selection scheme, especially if some apparent unsoundnesses really are not?

The economic values of cow traits need more work. Maintenance costs seem to be nearly accounted for by weight alone. Lean-fat composition of weight must have some small effect. Apparently fatter cows have less maintenance cost. We need to understand more accurately the dynamics of changing weights and degrees of finish as they relate to costs. Also, the maintenance cost situation under different kinds of grazing systems must be determined. Perhaps this could be investigated at a station like this or cooperatively with ranchers. Of course, the genetic and environmental correlations of cow traits with calf traits are an immediate need.

I have suggested for some time that there is not necessarily one kind of ideal beef animal. We produce meat from species varying tremendously in size, shape and carcass characteristics. Perhaps a range of sizes of beef cattle could give similar returns on investment if a production and marketing system is geared to each.

The evaluation of breeds and their cross performance depends on solving some of the same problems just discussed in connection with net merit or overall efficiency. We need, and have underway, a much wider experience with breeds than we have had in the past. Our data will be a little late. We should have been in more of a leadership position in this than we were.

How methodically should we try to measure heterosis and especially maternal heterosis in carefully designed experiments as breeds change and more breeds must be evaluated? Shouldn't we concentrate on guessing some potentially good 3 or 4-way crosses and getting adequate data on their overall comparative performance? I know of no area in our meat animal breeding research that cries out for regional or national planning more so than does this matter of evaluating breeds and utilizing them in crossbreeding systems.

We need to understand more completely the breakdown of nutrient use, especially energy, into its component parts. What is the interplay between consumption gain

and composition? We need to separate this into its genetic and environmental components. This means we need experimental techniques which allow collecting data on many animals at reasonable cost. When we select for lean animals what happens to consumption and gain, and vice versa?

How much energy is required to build and also to maintain fat and lean tissue other than the energy stored? Bill Flatt's work with dairy cows indicates that energy storage as fat on the animal, with later mobilization, may not be so inefficient after all. What is the nature of differences in energy utilization, if there are any other than those associated with time? To what extent are they genetic? If we would disentangle the consumption-gain-composition complex, with its circularity of cause and effect, and know the genetic and environmental parameters, we could formulate answers to many practical questions in meat animals.

Experiments where fairly large numbers of animals are individually fed, using live predictors of body composition could yield data on these questions. Groups could be fed at various levels of gain including maintenance, at various weights. In this way the differences in energy costs of maintaining and building lean and fat tissue could be ascertained.

The data suggest a positive genetic and negative environmental correlation between outside fat and marbling. If this is so, what is the explanation in terms of the mechanisms of depositing fat? Can we consistently produce lean carcasses with marbling? And the obvious counter question, do we need marbling?

We must remain always cognizant of reproduction. I fear the tremendous change in carcass composition of the hog has left us with a critter that has a lower overall fitness in his environment.

One cannot help but look at the formula for genetic change and wonder how we can affect it dramatically. New genetic material offers a chance for an immediate increase in the mean for some important traits, hopefully without too much damage to others. Some increase in genic variance might also be anticipated. A lot of our work has been on small increases in the accuracy of selection. Occasionally we make some inroads on selection differential. One can visualize that accuracy of selection might be increased by quantitative measurements of hormones, enzymes, etc., which have high genetic correlation with desired production traits and perhaps could be measured early in life. What are the chances for drastic reductions in generation interval? Could gamete development, especially for males, be speeded up? Might we learn to enhance the maturation rate of germinal tissue, either _in vivo_ or _in vitro_, so that a bull calf might be "mated" shortly after birth, or even before? Any inroads on this would be helpful. Perhaps someday a fertilized egg can be turned into a functional sperm or egg in a few weeks, days or hours. We would also need to measure something in the cell on which to base selection, however, in order to turn a generation a day. Perhaps when we can do all that we will simply make steaks to order from their chemical constituents.

Lastly I would like to say that we now have more incentive to seek answers in beef cattle breeding than ever before. Our industry is at last ready for us. The direct participation of animal breeding research workers in industry action on the breeding of beef cattle, a hope and desire for most of us in the 60's, will become an accepted reality in this decade.

BEEF CATTLE RESEARCH PROGRAM FOR THE U. S. MEAT ANIMAL RESEARCH CENTER

Keith E. Gregory[1]

The basic objective of the beef cattle research program at the U. S. Meat Animal Research Center is to make a maximum contribution to the development of new technology that can be implemented into production programs to increase the efficiency of conversion of feed and other resources available into highly palatable and nutritious beef. To make this contribution, the U.S. Meat Animal Research Center beef cattle research program must be jointly planned and cooperatively executed with other USDA and State Agricultural Experiment Station programs. Joint planning and cooperative execution of research programs are essential to the most effective use of the resources available to research interests.

To insure that research priorities are assigned in the most effective manner relating to industry problems and to the utilization of research resources, it is essential that the beef cattle industry and research interests maintain close liaison. The U. S. Meat Animal Research Center program is depending upon advisory committees to give assistance that will result in the assignment of priorities consistent with present and future problems of the beef cattle industry and with maximizing the use of research resources.

The research efforts at the U. S. Meat Animal Research Center will include swine and sheep, in addition to beef cattle. Approximately one-half of the research efforts will be on beef cattle, one-fourth with sheep, and one-fourth with swine.

In addition to the Animal Science Research Division interests at the U. S. Meat Animal Research Center, other Research Divisions of ARS, USDA, that will participate in the program include Agricultural Engineering, Market Quality, Crops, Soil and Water Conservation, Entomology and Western Utilization. Also, the Production Economics Research Division, ERS, USDA, will participate in the program at the Research Center. The Nebraska Agricultural Experiment Station is an important cooperator in the U. S. Meat Animal Research Center program and it is anticipated that cooperative efforts will develop with other State Agricultural Experiment Stations.

The research program to be implemented with beef cattle at the U. S. Meat Animal Research Center will be directed toward developing new technology that can be implemented by the beef cattle industry to reduce production costs of edible beef with maximum palatability. Attention will be given to the major factors that influence profit, including biological, physical, and managerial. This will include the full production cycle. The research program is being designed as an integrated effort involving the major scientific disciplines that relate to animal agriculture. This includes feed production, harvesting, handling, storage and utilization; animal housing and waste management; breeding and reproduction; feeding; meats technology

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[1]Director, U. S. Meat Animal Research Center, Clay Center, Nebraska, Animal Science Research Division, ARS, USDA.

and management systems as they relate to reproduction, growth, feed efficiency and carcass characteristics. New knowledge evolving from these programs is expected to contribute toward optimizing resource inputs in accord with economic situations and new technological developments.

While many of the specific projects will not be planned until facilities have been developed and scientific staff recruited, major problem areas of the beef cattle industry scheduled to receive attention in the research program are: (1) reproduction, (2) feed efficiency, (3) carcass merit, (4) management systems on a life cycle basis, and (5) waste management.

Reproduction:

Because of the high fixed costs associated with the maintenance of the national breeding herd of beef cattle, small increases in reproductive rate have a large effect on costs per unit of production and thus on profit margins. Research in this area will involve both sexes, and the disciplines of physiology, endocrinology, neurology, biochemistry, nutrition and genetics will be employed to increase understanding of factors that influence puberty, estrus, ovulation, conception, implantation, embryonic and fetal mortality, parturition and early postnatal mortality. This research will involve studies on male and female germ cell metabolism with the objective of developing improved procedures for preservation and storage of germ cells from both sexes. Efforts will be directed toward the development of methods of separation of male and female producing sperm cells in order to control sex of offspring.

Feed Efficiency:

Improvement in feed utilization at all stages of the life cycle by increasing utilization of nutrients from feeds, increasing efficiency of metabolic processes related to maintenance and the synthesis of edible product has great potential for reducing production costs of the beef cattle industry. The major objective in this area of work is to develop new knowledge that can be implemented into production programs to increase the amount of high quality edible product per unit of available feed resource.

The research in this area will be on a full life cycle basis and will involve the integration of the disciplines of genetics, biochemistry-nutrition, microbiology, and physiology to gain an understanding of the major factors associated with differences in efficiency of feed utilization including physical and chemical treatment of feeds, appetite, maintenance, digestion, metabolic processes and tissue deposition. This will involve the investigation of factors such as size, and genetic and environmental factors independent of size, that influence requirements for maintenance and growth of different tissues.

Techniques to be employed include the use of respiration chambers, and the effects of climatic environment (temperature, humidity, and air velocity) will be investigated by the use of appropriate chambers to control these variables.

Carcass Merit:

Unflavorable lean to fat ratios are a major problem in beef cattle carcasses. Excessive amounts of fat trim greatly increase the production costs per unit of

edible product. The objective of research in this area is to develop technology that may be implemented by the beef cattle industry to reduce the amount of fat per unit of edible product while maintaining or improving the palatability of the edible product. Genetic and environmental factors that influence development of different tissues, distribution of fat and lean, and meat palatability will be investigated. Gaining an understanding of factors that influence palatability of meat and the proportion of edible meat in the carcass is the aim of this research effort.

Management Systems on a Life Cycle Basis:

The number of variables (economic, biological, and physical) with which livestock producers in the future will have to cope will likely continue to increase and will probably become more complex. The alternatives available to producers to increase production efficiency will become more numerous and more dependent on specific economic and production situations. Increased research emphasis is needed to identify and quantify the major factors affecting production costs and returns to capital and management in different production and economic situations. Research in this area will relate to gaining understanding that will result in more optimum use of resources in different economic and production situations.

Waste Management:

Pollution is a national problem. The extent to which the beef cattle industry contributes to this problem has not been identified. Research in this area will relate to identification of the nature and the magnitude of the pollution problem associated with the beef cattle industry and to the development of feasible technology for managing beef cattle waste so that the beef cattle industry is not a factor in either air or water pollution.

GERM PLASM EVALUATION

A major project in progress at the U. S. Meat Animal Research Center that represents an important area of work relates to the evaluation of cattle germ plasm. This is the first cycle of a long-term research effort that is planned for this area. It is planned to include other breeds in subsequent cycles of this program. It is the intent of this program to evaluate breed differences in the full spectrum of economic traits and trait components relating to characterizing growth, feed efficiency, reproduction, maternal ability and the carcass. A basic objective of this program is to develop understanding relating to optimizing such biological factors as cow size, milk level, etc., to different feed environments and production situations. The cattle involved in the germ plasm evaluation program will contribute to studies in each of the five major problem areas discussed previously. The evaluation program is designed to consider the potential value of specific stocks in regard to their use: (1) as straightbreds, (2) in different types of breed crossing programs to utilize heterosis, and (3) for the development of new breeds.

Breed of Sire and Dam Comparisons in F_1 Crosses
1969 Through 1971 Breeding Seasons - (Table 1)

To initiate this program grade Hereford and Angus females are being mated to the following sire breeds (Table 1): Hereford, Angus, Jersey, South Devon, Charolais, Limousin and Simmental. These matings are being made during the 1969, 1970, and 1971 breeding seasons.

The male progeny produced from these matings will be castrated and fed out by breeding group to obtain growth, feed efficiency, and carcass data.

Breed of Sire and F_1 Dam Comparisons in 3-Breed Crosses
1971 Through 1975 Breeding Seasons - (Table 2)

The females produced from the 1969 through 1971 matings will be retained for three calf crops, to evaluate fertility and mothering ability traits of F_1 crosses and the transmitted influence of specific "sire breeds" in 3-breed crosses (Table 2). Some of these evaluations will be in confinement so that feed consumption of different breeding groups can be evaluated.

First Backcross and F_2, 1971-1975; Second Backcross and F_3, 1973-1977 - (Table 3)

Backcross (B_1) and F_1 *inter se* (i.e., F_2) matings as shown in Table 3 will be produced through the second backcross and through the production of F_3's to predict proportion of heterosis retained in rotation crossbreeding and in new breed formation involving these breed crosses.

Table 1. Mating Plans for 1969*, 1970 and 1971 Breeding Seasons

Breed of Dam	Breed of Sire						
	Hereford	Angus	Jersey	South Devon	Limousin	Simmental	Charolais
Hereford	X	X	X	X	X	X	X
Angus	X	X	X	X	X	X	X

*Approximately 900 calves produced from these matings in 1969.

Table 2. Mating Plans for 3-Way Crosses and Controls in the 1971 Through 1975 Breeding Seasons

Breed Group of Females	Breed of Sire					
	Hereford	Angus	Simmental	Charolais	Limousin	Other ?
Hereford	X[a]					
Angus		X[a]				
Angus x Hereford			X	X	X	X
Hereford x Angus			X	X	X	X
Jersey x Hereford		X	X	X	X	X
Jersey x Angus	X		X	X	X	X
South Devon x Hereford		X	X	X	X	X
South Devon x Angus	X		X	X	X	X
Limousin x Hereford		X	X	X		X
Limousin x Angus	X		X	X		X
Simmental x Hereford		X		X	X	X
Simmental x Angus	X			X	X	X
Charolais x Hereford		X	X		X	X
Charolais x Angus	X		X		X	X

[a]These are inter se Hereford-Hereford and Angus-Angus matings of unselected straightbred bulls and heifers born in 1970 through 1972 from Table 1. They serve as controls, for comparing F_1, F_2, F_3, 3-way, B_1 and B_2 matings made in different years since their expected genetic change is minimized and both rearing environment and age of dam will be the same as that for other breeding groups calving in the same year.

Table 3. Mating Plans for the Production of Backcrosses Through B_2 and F_2's and F_3's (1971 Through 1977 Breeding Seasons)[a]

Breed Group of Females	Breed of Sire[b]									
	Hereford	Angus	Simmental	Charolais	A x H	H x A	S x H	S x A	C x H	C x A
Hereford	(X)[c]									
Angus		(X)[c]								
Angus x Hereford					X					
Hereford x Angus						X				
Simmental x Hereford			X				X			
Simmental x Angus			X					X		
Charolais x Hereford				X					X	
Charolais x Angus				X						X

[a]This table supplements Table 2, to show the continuation of specific matings through the production of B_2's and F_3's, to evaluate heterosis and recombination effects.

[b]Bulls used in the straightbred control and in the F_2 matings are unselected samples of bulls produced in corresponding straightbred and F_1 matings of Table 1.

[c]These are the same control matings shown in Table 2.

U.S. MEAT ANIMAL RESEARCH CENTER TOUR
By
JOINT REGIONAL BEEF CATTLE BREEDING TECHNICAL COMMITTEES

The tour of USMARC facilities by the Joint Committees on August 11 was preceded by a statement by Dr. Keith Gregory, Director of the Center, on the development of the Center to date, livestock populations currently involved in research programs, and future development of facilities and research programs. Members of the tour group then were loaded on buses at the Clarke Hotel in Hastings, Nebraska, and embarked on a tour of the Center.

During the three and one-half hour tour of the Center, participants were shown much of the land and associated resources available to the U.S. Meat Animal Research Center for utilization in research programs. Of particular interest to the group was the observation of beef cattle and sheep populations currently involved in various experimental programs. Observed were beef cattle populations of the Hereford, Angus, Milking Shorthorn, Red Dane, Brown Swiss, Red Poll and Charolais breeds and approximately 950 Hereford and Angus females with calves from seven breeds of bulls in a major germ plasm evaluation program. Breeds of bulls used in this study were Simmental, Limousine, Charolais, South Devon, Jersey, Hereford, and Angus. At the several stops made to view these cattle, MARC scientists outlined the research objectives for each group of cattle.

Major developments of facilities outlined on the tour included a 3600 head capacity feedlot for beef cattle growing and finishing program and cow-calf confinement feeding research, new headquarters laboratory and office complex, and feed mill and animal research facilities.

A brief tour of the sheep research facilities and discussion of sheep research programs was also included.

THE ROLE OF BEEF CATTLE BREEDING RESEARCH IN CHARACTERIZING GERM PLASM RESOURCES

T. C. Cartwright

The title assigned to me implies characterizing germ plasm resources for the purpose of utilizing existing variability to increase efficiency of beef production. I believe that this is potentially fruitful research which has not been given high enough priority in the past. Research characterizing germ plasm resources yields information useful for making more judicious breed reflections and for designing more efficient breeding systems. It is also useful in revealing the correct direction for selection emphasis within purebred populations and adds insight into properly setting priorities for expenditure of beef cattle breeding research funds.

Two broad objectives are suggested for research projects which involve characterizing germ plasm resources of cattle: (1) to determine the extent and nature of genetic variability of important characters within and among existing cattle populations and (2) to determine how to best utilize this genetic variability to increase total efficiency of beef production. Characterizing germ plasm resources must include assessment of both individual and population characters. Environmental conditions of production is important knowledge and should be carefully and fully described. Economic parameters are also important. Animal breeders have given some thought to relative economic values for characters, often only cursorily, for use in constructing selection indexes. The literature indicates even less thought has been given to economic values for use in breeding and production systems. Too often these values for characters have been thought of or, at least, treated as if they were universal constants. Relative economic values appropriate for characters may vary considerably for sub-classes such as:

1. Productions resources (land, capital, skill, etc.)
2. Climatic conditions (tropical, temperate, humid, arid, etc.)
3. Management system (extensive, intensive, confined, integrated, etc.)
4. Breeding system (straight, cross, specialized, generalized, etc.)
5. Market (local, contract, specialty, etc.)
6. Objective (investment, hobby, tax advantage, cash flow, etc.)

The number of sublcasses, depending on the fineness of classification, may be substantial. We should strive to detect common elements of desirability of traits (trait is used here to refer to a level of a character such as high ADG or small mature size) among various subclasses, but it is clear that we should be able to respond in a logical, helpful manner (or advise others how to respond) to relatively unique situations.

Priorities must be set to limit the number of characters considered in order to increase return to research input. To aid in setting priorities cattle may be classified into two basic phases of production:

Phase I Increasing number - the cow herd.
Phase II Increasing weight - the steer.

Steer as used here refers to all cattle produced for slaughter rather than reproduction.

Separating these two phases is not intended to imply that they are independent in either the biologic or economic sense. The cow herd phase, which includes substantial weight increase, appears to be the more important phase. Table 1 shows about two cattle in the cow herd for each steer. U. S. cattle census figures lend substantiation to this calculation. Reports indicate about 50 million cows in the U. S. and about 25 million finished steers slaughtered each year. (The comparison using U. S. totals is inexact but should be approximately correct. Replacement heifers left out of the cow count tend to balance slaughter calves left out of the finished steer count).

TABLE 1. A BEEF HERD PRODUCING 100 SALE CALVES PER YEAR[a]

Brood cows	150
Replacement heifers, yearlings	20
Replacement calves	20
Bulls	6
Subtotal	196
Sale calves	100
Total	296

[a]Assumptions included:
80% net calf crop;
13% cow replacement/year;
4% bulls.

It appears important to characterize average performance and variability of populations for characters that contribute directly and importantly to efficiency of production in Phase 1. These characters include:

Feed requirement
Age at puberty
Lifetime and annual fertility
Calving ability
Milking ability
Adaptability
Longevity
Tractability
Soundness and hardiness
Frequency of deleterious recessives

The first character, feed requirement is especially complex and interrelated with most of the other characters. In order to be meaningful, it must eventually be put in terms such as:

$$\frac{\text{Cattle output}}{\text{Feed input}}$$

Feed input includes pasture and range and cattle output includes all sales. In many cases, the most useful measure is the dollar value of input and output. The concept

of a least-cost cow herd, which is similar to but not as simple as a least-cost ration for the feedlot, is implied if this ratio is maximized. (If the objective is to maximize return of beef from a given input of resources rather than to maximize profit, then other units of input and output may be more appropriate.)

A knowledge of mature size and the pattern of reaching mature size are essential for evaluating feed requirements. Several, if not all, of the other characters listed, are correlated with weight-age characteristics. Relatively little is known about biological interpretation of growth curves and correlations among growth curve parameters and other characters in beef cattle. Variability of these parameters between and within breeds may be illustrated by using data from Jerseys, Angus-Brahman and Hereford-Brahman (figure 1 taken from Brown, 1970). The data from figure 1 illustrate differences between breed types and those from figure 2 within breed types. The later figure suggests that some of us have been considering the correlation between mature size and growth characters to be higher than it may be in some populations. These figures illustrate considerable variability within and between breeds, but they fail to separate genetic from other sources. Gain during a 140-day period leaves much to be desired and may be very misleading if taken as a criterion of efficiency of total production. At least consideration of mature size, preferably the entire growth pattern, must be included in breed characterization.

Fertility is usually considered only on a yearly basis. Variation in age at puberty and longevity may cause considerable variation in fertility considered on a lifetime basis. Neither a yearly nor a lifetime basis is separately adequate to characterize fertility, but both are important. For example, consider two herds with an average annual net fertility of 80%. If one herd calves first at 24 months of age and maintains an average age of 6 years compared to another herd which calves first at 33 months and has an average age of 5 years, the fraction of heifer calves needed as replacements is 26 vs. 42. The excess of calves available for sale is 10% more in the first herd or the equivalent of about 75% increase in fertility. Also, the average annual female selection differential possible is about 5% greater even though cow generation is longer.

Longitudinal fertility data, which include longevity, are indicated for research consideration just as longitudinal growth data are indicated.

The value of milking ability is currently appreciated on a more sophisticated basis because of the advent of widespread use of dairy breeds in research beef herds. Early weaning has caught the fancy of many. For some conditions light weaning may also have advantages similar to early weaning. The inherent ability of the Hereford to limit milk production may be a valuable trait in some straightbred operations and even more valuable for operations crossbreeding with dairy breeds. Milk production, measured directly or indirectly, must be an important character. Environmental conditions should be considered more closely and described in more detail for this character than perhaps any other Phase I character.

Characters which contribute to efficiency of production in Phase II, steers, include:

Pre- and postweaning rate of gain
Pre- and postweaning rate of finish
Efficiency of Feed utilization
Carcass cutout
Beef quality

These characters are intercorrelated. Rate of gain has some importance independent of efficiency of feed utilization because the length of time a steer is held in the feedlot (or other place) is associated with an expense independent of feed. Rate of finish has importance independent of efficiency of feed utilization principally because it is a major factor in determining grade. Efficiency of feed utilization, the real point of interest, may be divided into three primary components as functions of:

(1) Nutrient requirements for maintenance in relation to weight gain and time
(2) Composition of gain
(3) Intrinsic factors

We are reasonably well aware of the differences in maturity per unit of time or per unit of weight which are characteristic of cattle of different mature sizes. We don't always appear to use this knowledge well in practice or in research planning. Research projects involved in breed comparison should take into account the optimum weight and age for steers to be slaughtered giving consideration to slaughtering each breeding type at its "best" weight within readily marketable limits for the present and for the foreseeable future. An interesting comparison from a study by Joandet and Cartwright (1969) indicated that slaughtering steers at about 75% of optimum weight reduces efficiency of beef production by about the same amount as a 10% reduction of fertility in the cow herd.

As research workers in a distressingly slow moving field we must, of course, look ahead. The limits of weight and fatness that are often considered readily acceptable at the market place have a severely limiting influence on breeding objectives. If weight and finish are fixed, then our breeding opportunities are correspondingly limited--not fixed but restrictively limited. Does the future hold a place for a 1500 to 1600 pound steer of good or standard grade? Will the industry accept and/or adjust to such a beast if breeders make it available or demonstrate its availability?

Other than the characteristics related to rate of finish and rate of gain, the usefulness of carcass and meat characterization is not obvious. There are great opportunities for technological and managerial improvement, and I think they will continue to come rapidly. Animal breeders may do some of this research (from necessity or interest), but the useful variability appears to be largely environmental. The results may be quite useful to animal breeders but not in the sense that they are going to make genetic improvement in these characters except through weight-age manipulation.

Animal breeding research must, at least, include monitoring carcass and beef quality characters especially of recent or potential introductions. There is apparently sufficient variability in fat deposition tendencies to warrant more thorough planning and data collection. Contrasts between endomorphic and mesomorphic types such as can be observed in Angus and Charolais, for example, suggest basic differences in inherent fat deposition ability independent of stage of maturity and environment.

Characterizing steers, I believe, can be essentially reduced to weight-age and fat deposition records taking care not to overlook weight-age-finish relationships.

Recent interest in germ plasm sources largely unexploited in the U. S. has been generally restricted to cattle that have traits desirable for Phase II (i.e., sire line cattle) and perhaps for general purpose use or rotational crossing. It is clear that the trend is presently overlooking cattle well suited for Phase I (i.e., dam line cattle). Not only are new sources being overlooked, but breeders and breed associations appear to be following programs that will transform their cattle more to Phase II, and, consequently, though unintentionally, away from Phase I.

The most urgent need at present, in my opinion, is for animal breeding research to design more efficient methods of utilizing genetic variability presently available. In the process we will improve our selection of genetic source to evaluate and will better understand the changes needed in purebreds and the ramifications of selection programs for purebreds. Also, the need for pragmatic research results to help sustain the source of our funds adds a compelling incentive.

The separation of Phase I and Phase II emphasizes the divergence of traits desirable in the cow herd and in steers. The most feasible solution appears to be designing breeding and production systems which tend to bypass the undesirable and utilize the desirable traits. Such methods as linear programming offer a good starting point for evaluating breeding systems designed for various management and market situations. Investigation of several limited systems (Long and Fitzhugh, 1969) has intrigued us to refine techniques and investigate further. To illustrate this approach a linear program is used which is simplified by considering a confinement system of beef cattle production (Cows et al.kept in a feedlot) so that accounting for value, consumption and utilization of nutrients requires fewer unrealistic assumptions. The systems, input data, etc. and results are summarized below. The "solutions" illustrate, among other things, that the balancing effects between Phase I and Phase II of three contrasting breeding systems and types of cattle are of vital importance to animal breeders. Isolated, single character characterization is not sufficient and may even lead to procedures which reduce rather than increase efficiency.

A point that I have attempted to develop is that data on nutrient requirements, levels of production, value of product and other production factors are often either not available or not applicable as input information to test efficiency of breeds or breeding systems for sets of environmental conditions. A valuable contribution to beef cattle breeding that I believe should receive high priority, would be filling this information shortage so that more sophisticated, adequate methods of evaluation can be employed. Animal breeders will probably have to be responsible for collecting a good portion of the resource data he needs, but if motivated and informed, research workers in other fields could and probably would aid even more than they have in the past in compilating suitable data. The responsibility for design, especially to include controls or other bases for meaningful comparisons, should rest mainly with the animal breeder.

Without belaboring the necessity for animal breeding research to direct its objects toward the future, characterizing germ plasm resources should be done with the awareness that our research objectives may be required to, or well advised to, include evaluation of the effect of application of the research results on broad based considerations such as the return of food value per unit of natural resource invested or the effect on the gross state product as well as individual profit.

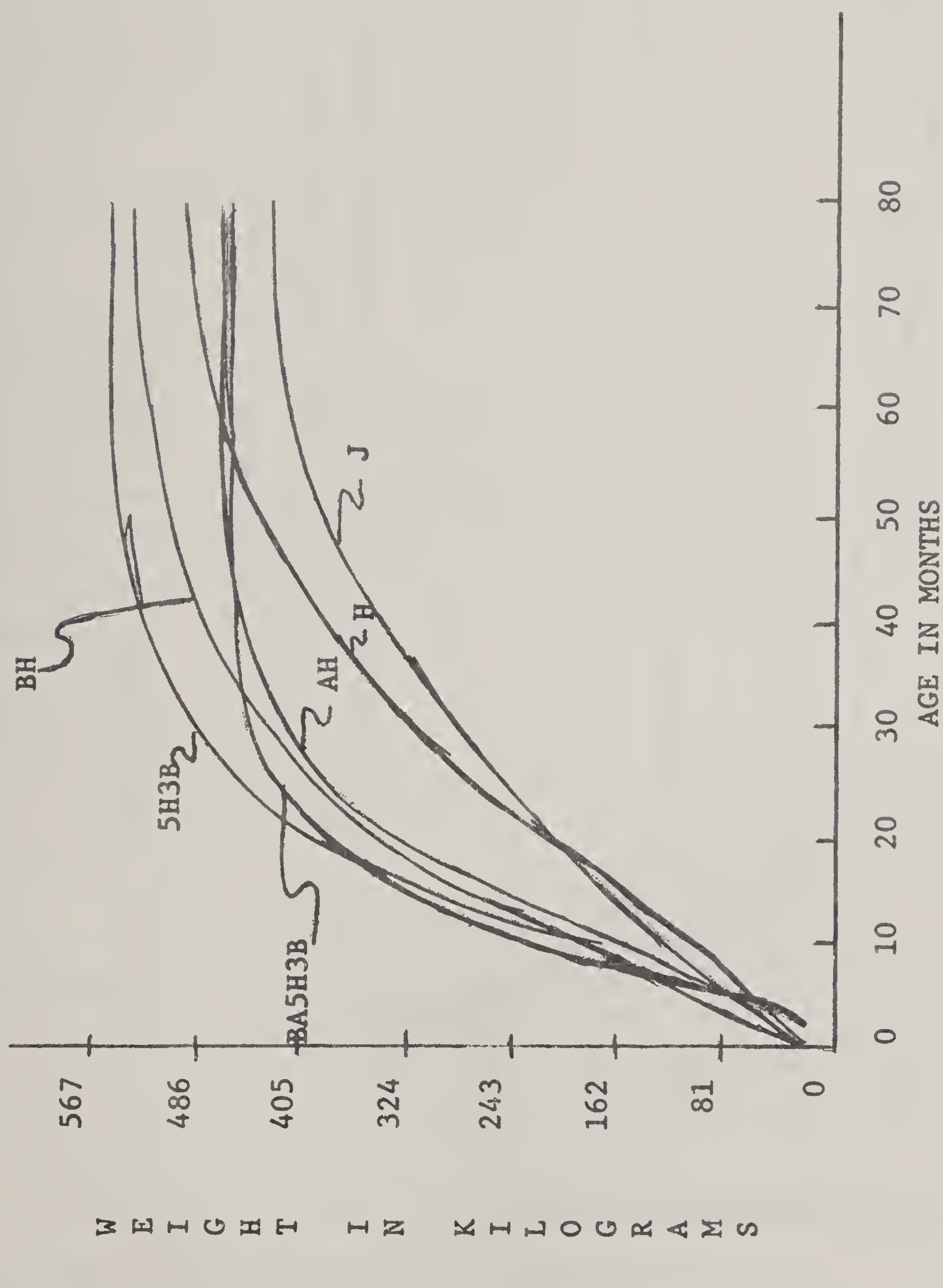

Figure 1. Mean growth curves for six breed groups.

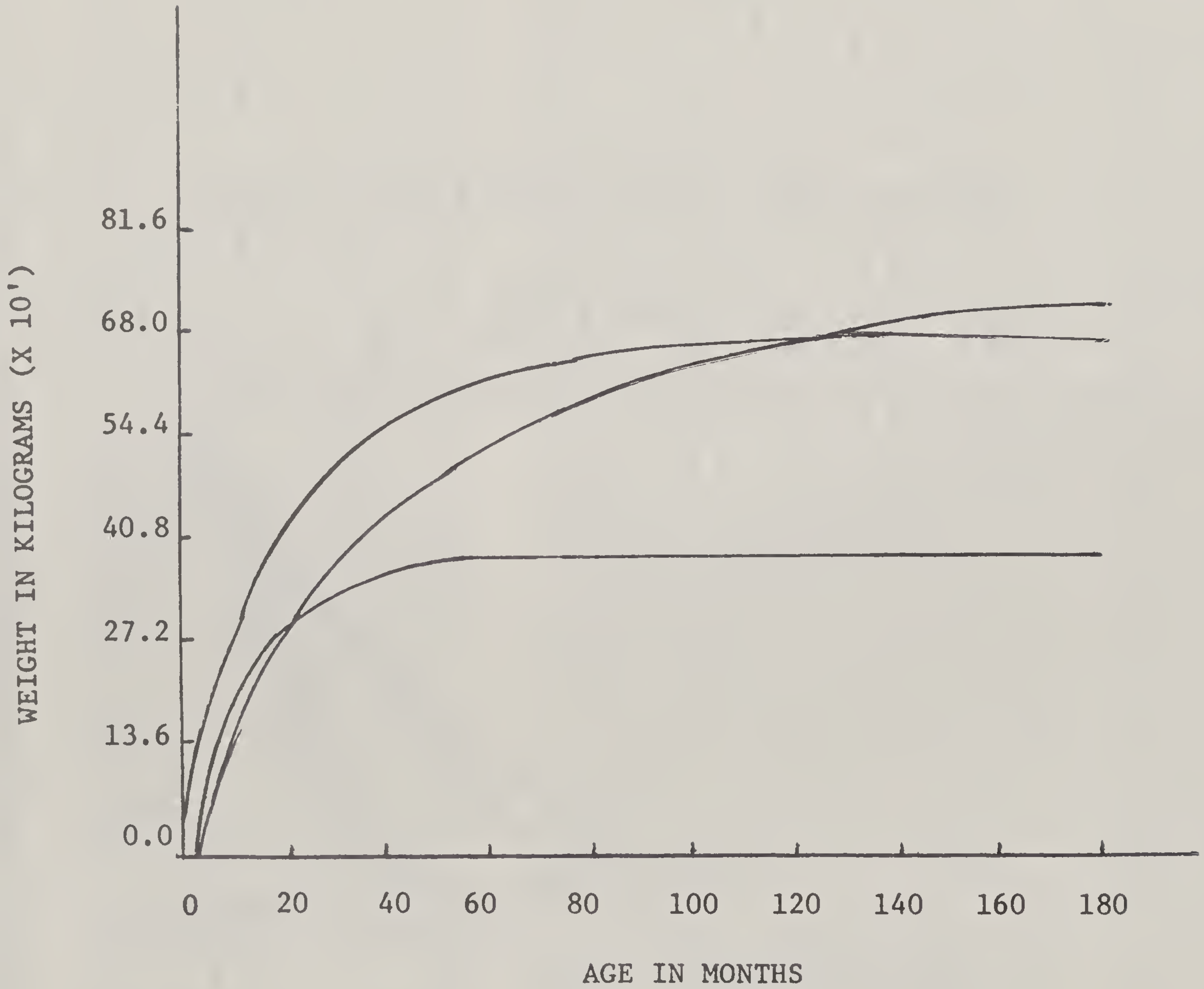

Figure 2. Growth curves for 3 B-H individuals.

BREEDING SYSTEMS AND INPUT DATA*

	System I Brahman - Hereford cows. Crisscross matings to produce replacements. Charolais X B-H to produce sale calves	System II Angus - Jersey cows. Crisscross matings to produce replacements. Charolais X A-J to produce sale calves	System III P. B. Angus
Mature wt.,	517 kg	370 kg	430 kg
Annual replacements	13 %	15 %	16 %
Age at 1st calf	27 mo	23 mo	25 mo
Milk yield, 180 day	1000 kg	1000 kg	675 kg
Weaned %	84 %	84 %	81 %
180 day wean wt.:			
. Replacement[a]	195 kg	172 kg	174 kg
. Sale[b]	211 kg	200 kg	174 kg
Feedlot ADG[c]			
. Replacement [a]	1.043 kg	0.862 kg	
. Sale [b]	1.179 kg	1.088 kg	0.95 kg
. Sale [b]	1.088 kg	0.998 kg	0.82 kg
Sale price, kg			
Weaned	$ .70	$ .70	$ .70
Backgrounded	.68	.68	.68
Fed	.60	.60	.60
Cull cow	.33	.33	.33

[a]Crisscross H-B, crisscross A-J, or purebred Angus
[b]Charolais sire x H-B, Charolais sire x A-J or purebred Angus
[c] = steer only, = heifer or cow

*Prepared by Charles R. Long, in consultation with T. C. Cartwright and C. F. Lard, Texas A&M University, by use of linear program methods.

Linear Programming methods were used to obtain an optimal solution imposing the following assumptions, constraints and procedures:

1. All nutrients were obtained from least cost rations (computed in a separate program) of feed readily available and widely used in feedlots in Texas. Conclusions drawn from this illustration are likely to be nearer the truth if all production is assumed to be in confinement (feedlot).

2. Only nutrient costs were considered.

3. The production and market values from page 1 were used.

4. Nutrient requirements were obtained from N.R.C. 1970 Nutrient Requirements of Domestic Animals, No. 4. Nutrient Requirements of Beef Cattle. National Research Council, Washington, D. C.

5. A fixed amount of capital was available to purchase nutrients. It was set at (adjusted to) $16,705.65 so that a cow herd of 100 would be maintained for System II.

6. Since capital was fixed, gross return was maximized.

The table below gives the optimal solutions. When the three breeding systems are included, System II only is included in the optimal solution. In order to obtain comparisons, an L. P. using only System I was run and then an L. P. for only System III was run. In order to simplify comparisons, numbers and corresponding production values were adjusted to the equivalent of a 100 cow herd for the optimal solution (System II).

OPTIMAL SOLUTIONS FOR THREE COMBINATIONS OF BREEDING SYSTEMS

	System I** B-H Crisscross, C x B-H		System II* A-J Crisscross, C x A-J		System III** Purebred Angus	
No. of cows	74		100		93	
No. of sale calves:	53		69		60	
Weaned, sold	-		-		-	
Backgrounded, sold	-		15	a	-	
Back., fed, sold	53	a,b	54	b	60	a,b
No. cows culled, sold	10		15		15	
Wt. of calves & culls, kg:						
Weaned, sold	-		-		-	
Backgrounded, sold	-		3030		-	
Back., fed, sold	29,289		26,840		24,799	
Cows culled, sold	5,005		5,550		6,388	
Return, gross	$19,471.44		$20,307.22		$17,271.19	
Return over nutrient cost	$ 2,765.79		$ 3,601.57		$ 565.54	
Return, % of optimal sol.	77 %		100 %		16 %	

[a]Crisscross H-B, crisscross A-J or purebred Angus
[b]Charolais sire x H-B; Charolais sire x A-J or purebred Angus

*Optimal solution when all three breeding systems are included.
**Optimal solution when either System I or System III considered singly.

Stability of Optimal Solution with Respect to Cattle Price Changes -

Under the conditions given, using least cost rations based on current prevailing prices, the system of breeding which resulted in greatest return to investment in feed was System II. The ranges through which prices of cattle may be varied (one at a time) without causing a change in the solution are:

Weaned calf price:	$ .0000/kg to $ .7126/kg
Backgrounded calf price:	$ .6692/kg to $ .7625/kg
Fed steer or heifer price:	$ .5387/kg to $ .6163/kg
Cull cow price:	$ .1729/kg to $ .8658/kg

Number of cows and number of calves sold after weaning, backgrounding and feeding in the optimal solution at various critical price levels.[a]

Prices $/kg				SYSTEM	No of cows	No. of calves sold at weaning			No. of calves Bak. & sold			No. of calves Bak., fed & sold		
Wean calf	Bak. calf	Fed calf	Cull cow			Repl bred	Charo cross	Charo cross	Repl bred	Charo cross	Charo cross	Repl bred	Charo cross	Charo cross
0.0	.68	.60	.33	II	100	-	-	-	15	-	-	-	27	27
.7126	.68	.60	.33	II	101	15	-	-	-	-	-	-	27	27
.8009	.68	.60	.33	II	121	18	-	33	-	-	-	-	33	-
.8523	.68	.60	.33	II	155	23	42	42	-	-	-	-	-	-
1.00	.68	.60	.33	II	155	23	42	42	-	-	-	-	-	-
.70	0.0	.60	.33	II	101	15	-	-	-	-	-	-	27	27
.70	.6692	.60	.33	II	100	-	-	-	15	-	-	-	27	27
.70	.7625	.60	.33	II	116	-	-	-	17	-	31	-	31	-
.70	.8075	.60	.33	II	144	-	-	-	22	39	39	-	-	-
.70	1.00	.60	.33	II	144	-	-	-	22	39	39	-	-	-
.70	.68	0.0	.33	II	144	-	-	-	22	39	39	-	-	-
.70	.68	.5109	.33	II	116	-	-	-	17	-	31	-	31	-
.70	.68	.5387	.33	II	100	-	-	-	15	-	-	-	27	27
.70	.68	.6163	.33	II	93	-	-	-	-	-	-	14	25	25
.70	.68	1.00	.33	II	93	-	-	-	-	-	-	14	25	25
.70	.68	.60	0.0	II	93	-	-	-	-	-	-	14	25	25
.70	.68	.60	.1729	II	100	-	-	-	15	-	-	-	27	27
.70	.68	.60	.8658	II	101	15	-	-	-	-	-	-	27	27
.70	.68	.60	.9829	II	121	18	-	33	-	-	-	-	33	-
.70	.68	.60	1.00	II	121	18	-	33	-	-	-	-	33	-

[a]Prices were varied from 0.0 to $1.00.
The three breeding systems were considered but only System II entered the solution.
Only points of major change are indicated.

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EVALUATION AND UTILIZATION OF BREED DIFFERENCES

Gordon Dickerson

As I remember previous joint meetings of the Southern, Western and North Central Technical Committees on beef cattle breeding, there have been definite changes in emphasis. In 1949 at Miles City we were giving much attention to the development of inbred lines of cattle with selection. In 1960 at Stillwater our attention had shifted more to selection without inbreeding and the use of control procedures to measure selection response experimentally. As we meet in 1970 much attention is being given to evaluation and utilization of breed differences.

Why focus on breed and cross differences?

Breed differences are an important part of the total genetic variation available to produce genetic improvement. Unkike the genetic variation available within breeds, differences between breeds can be quickly exploited. If breed differences are estimated accurately, average heritability realized in utilizing such differences is 100% ± errors of sampling in particular applications. Genetic variation among existing breeds also provides great flexibility in producing quickly the combinations of individual and maternal genotypes best adapted to a particular management system and market requirement. Also, some crossbreeding systems permit more optimum combination of individual and maternal genetic components of performance than can be obtained within a single interbreeding population.

We should remember, however, that gain from crossbreeding and selection among breeds are a one-shot affair. They are the "frosting on the cake". Continued improvement requires selection within the parent breeds or within new "synthetic" breeds. (Figure 1).

Composition of Population Differences.

Compared with a hypothetical population representing all possible crosses among existing breeds of cattle, our present breeds can be thought of as mildly inbred lines which differ from each other in (a) mean gene frequencies due to divergence in selection for particular characteristics and for adaptation to particular environments and also to random drift in gene frequencies due to limited population size, (b) average heterozygosity relative to each other and relative to hypothetical population af all possible crossbreds. Thus, breed differences include not only the average effects of genes in crosses but also deviations due to dominance and to epistatic gene effects which are influenced by the level of heterozygosity or inbreeding. Except for the chromosome controlling sexual dimorphism male and female parents are required to have the same average genotypes; Figure 2 shows mean level of performance changing in a curvilinear fashion with increased inbreeding, relative to the mean for all possible crossbreds. This curvilinearity is based on the general assumption that the detrimental effect of losing an additional useful gene effect becomes more serious as the total number of useful gene effects present in the system declines with inbreeding. There is a fair amount of experimental evidence supporting this assumption, in addition to its theoretical reasonableness. If true, it may help

explain why application of reciprocal recurrent selection to increase cross performance has not been as rapidly successful as would have been expected if performance were linearly related to percentage of heterozygosity. In actual data with large animals it is difficult to detect deviations from linearity in inbreeding depression, partly because of selective elimination of the poorer inbred lines as the level of inbreeding becomes greater.

In utilizing breed differences through crossbreeding, we not only select the breeds which have the best average transmitted influence on performance, but we also utilize the higher percentage of heterozygosity of the crossbred progeny or the crossbred parent to activate useful dominance and epistatic gene effects. Thus improved performance from crossbreeding is a combination of superiority in the mean frequency of favorable genes and in the level of heterozygosity in particular cross combinations as illustrated in figure 3. As shown in figure 4, optimum utilization of breeds involves choosing breeds or F_1 crosses superior in maternal performance as female parents and those relatively more superior in postweaning traits as male parents.

Probably the most important single type of information in evaluating breeds is the mean transmitted effect on individual and maternal cross performance. This measure of breed differences has less error from level of inbreeding and from epistasis than performance of the purebreeds themselves. Ranking in purebred performance, of course, is useful in predicting average transmitted effects in crosses but the correlation between purebred and crossbred performance is limited by breed differences in level of inbreeding, in epistatic interaction and, of course, by sampling errors of estimation.

Alternatives in Breed Utilization.

Expansion of superior breeds and corresponding reduction of less well-adapted breeds has been a widely used method of breed utilization. The method most commonly used, of course, has been "grading up" through the more adapted breeds. Four or five decades ago our counter-parts were busily engaged in encouraging this type of genetic improvement of the livestock population. Grading up or backcrossing to the superior breeds is quite efficient because it utilizes the reproductive capacity of the breeds which are being displaced. Another alternative is simply expanding the superior breeds by doing less culling within the breed. This method seems clearly less efficient since it reduces the amount of selection. However, if the relaxed culling only applies to females, this advantage might not be very serious. Studies of the expansion of the Friesian population in Britain have indicated that reduced culling of females was the method actually used, rather than grading up.

Some system of crossbreeding is likely to be effective in utilizing breed differences because the greater heterozygosity of crossbreds means heterosis in both individual and maternal performance and also may permit exploitation of breed differences in maternal versus transmitted individual effects on performance.

Specific crossbred combinations make maximum use of breed differences in male versus female parents superiority, but their use is limited when the rate of reproduction is low as in cattle. We will use h^{i}_{ab} and h^{m}_{ab} to indicate heterosis for individual and maternal traits and g^{i}_{a} and g^{m}_{a} to symbolize breeding values.

Losses of epistatic superiority maintained by selection within the parent purebreed through recombination in gametes from crosses is indicated as r^I_{ab} and r^M_{ab}. Subscripts indicate parent breeds. Then compare the expected performance of specific crosses relative to the purebred mean of the constituent breeds as follows:

$$2 \text{ Breed } (F_1) = +h^I_{AB} + 1/2(g^M_B - g^M_A)$$

$$3 \text{ Breed, } C(AB) = 1/2(h^I_{CA}+h^I_{CB}) + h^M_{AB} + 1/4 r^I_{ab} + \frac{g^M_A+g^M_B-2g^M_C}{4}$$

$$AB(c) = (h^I_{AC}+h^I_{BC}) + h^P_{AB} + 1/4 r^I_{ab} + 2g^M_c - g^M_A - g^M_B$$

$$4 \text{ Breed, } (AB)(CD) = 1/4(h^I_{AC}+h^I_{AD}+h^I_{BC}+h^I_{BD}) + h^P_{AB} + h^M_{CD} + \left(\frac{g^M_C+g^M_D-g^M_A-g^M_B}{4}\right)$$

$$+ \left(\frac{r^I_{ab}+r^I_{cd}}{4}\right)$$

$$4 \text{ Breed, } (AB)(CD) = \bar{h}^I + \bar{h}^P + \bar{h}^M + \frac{\overline{\Delta g}^M + \bar{r}^I}{2}$$

Thus, in first crosses or two-breed crosses, one gains the full heterosis for individual performance and one-half of the pure breed difference in maternal performance. Essentially maximum utilization of heterosis and transmitted differences in maternal performance is obtained in the specific three-breed cross of a superior male breed with the F_1 cross of two superior female breeds. Note that the full gain in heterosis for both individual and maternal effects is obtained and only 1/4 approximately of the maximum possible probability of recombination effects between chromosomes of different breeds is expected. The three breed cross of F_1 sires on purebred dam utilizes heterosis in male reproductive performance and reverses the difference in breeding value for maternal performance. The four breed cross utilizes fully heterosis in individual, paternal and maternal performance and any difference in breeding value for maternal performance between the two lines on the female side. (However, there is twice as much opportunity for recombination effects in the gametes producing the progeny.) In recent times corn breeders have moved away from four breed crosses and toward three breed and single crosses for commercial production in order to reduce recombination effects and to utilize more elite lines. We have ignored breeding value differences in male reproductive performance (g^P).

Rotation crossbreeding utilizing only purebred males has the strong advantage of utilizing a high proportion of maximum potential heterozygosity with recombination effects kept relatively low because only the female parent produces recombination gametes. However there is a disadvantage that the same average genotype must be accepted for both individual and paternal performance except for that controlled by the sex chromosome. Also, there is less uniformity between generations, the progeny or the dam being determined half by the immediate purebred sire breed.

Formulas for 2-3-4-breed rotation:

$$2 \text{ Breed} = + 2/3(\bar{h}^I+\bar{h}^M) + 2/9(\bar{r}^I+\bar{r}^M)$$

$$3 \text{ Breed} = + 6/7(\bar{h}^I+\bar{h}^M) + 2/7(\bar{r}^I+\bar{r}^M)$$

$$4 \text{ Breed} = + 14/15(\bar{h}^I+\bar{h}^M) + 17/45(\bar{r}^I+\bar{r}^M)$$

Some of the advantages of specific and rotation cross-breeding can be combined by using males from the sire breed on females produced by rotation crossbreeding among breeds chosen for more largely maternal traits. Formula:

$$\text{Sire x 2 breed rotation female (AB)} = \bar{h}^I_C + 2/3h^M_{AB} + 2/9(r^I + r^M)_{AB} + \frac{g^M_A + g^M_B - 2g^M_C}{4}$$

In this case all of the individual heterosis and a large part of the maternal heterosis can be utilized with relatively little handicap from recombination effects and making considerable use of breed differences in maternal performance.

New "synthetic" breeds offer the same opportunity as rotation crossbreeding for retaining most of the individual and maternal heterosis which could be obtained in an F_1 individual. F_3 of N Breeds $= \frac{(n-1)}{n}(h^I + h^M + h^P + r^I + r^M + r^P)$ However, in synthetic breeds the base population is subject to recombination effects--if these are important--which are directly proportional to the expected level of heterozygosity. Also in synthetic breeds it is not possible to use different genotypes for the male and female parent. It is commonly assumed that rate of response to selection would be greater in a breed beginning with a crossbred base than in the parental pure breeds themselves. However if the number of genes affecting the various components of performance involved are quite large, then the change in additive genetic variance would be rather small. In his experiments selecting for post-weaning gain in mice, Comstock has now concluded that response has plateaued since about generation 43. He has now estimated the number of loci which have contributed to the response obtained to this point as being in the order of 200 to 300. This is for only one trait. Surely when both individual and maternal traits are considered the number of loci likely to be involved is very large and we probably should not expect any great change in the effectiveness of within breed selection from beginning with a crossbred foundation. The main advantage is likely to be in correcting the cumulated inbreeding effects present in the constituent pure breeds. Here it is very important to avoid the mistakes of the past by maintaining large enough effective population size so that the initial advantage of increased heterozygosity is not squandered by early re-inbreeding of the new breed.

It is apparent that the relative magnitude of heterosis recombination effects and of breeding values for individual and maternal performance determine the most advantageous method of utilizing genetic differences among breeds. The larger the individual and maternal heterosis is, the more advantage cross-breeding or synthetic breeds have over present pure breeds. The larger breed differences in maternal versus individual performance, the more important it is to use some type of specific cross rather than rotation, crossbreeding, or development of new synthetic breeds. If recombination loss of epistatic superiority maintained in the existing pure breeds by selection is important, then crossbreeding has a distinct advantage over synthetic breeds as a means of utilizing existing breed differences. Of course, the lower the rate or reproduction, the more difficult specific crossbreeding systems are and the more advantage there is in rotation crossbreeding or in synthetic breeds.

Estimation of Parameters.

Evidence concerning breed differences is obtained both from the pure breeds themselves, of course, and from crossbreeding. Even though confused by differences in accumulated inbreeding or epistatic gene effects, breed differences in purebred

performance certainly are indicative of major differences to be found when the breeds are used in crossing. Thus, preliminary screening of breeds with regard to individual and maternal traits certainly can be done on the basis of comparisons of purebred performance.

In crossbreeding evaluation the main effects of breed of sire on both individual and maternal performance of F_1 progeny is probably the most useful single kind of information to be obtained. Here we can utilize the general principle of factorial experimental design so that the precision of comparison of any two breeds of sire is determined primarily by the total numbers of progeny by breed of sire, and not by numbers in any specific cross from that breed of sire. This is true unless interaction between breed of sire and breed of dam or specific combining ability is important. If the purebreds are left out of the analysis, such interaction is very unlikely to be significant, with the levels of inbreeding to be found in domestic breeds of cattle. Thus, as one increases the number of breeds being evaluated in the same experiment, the required numbers of direct proportion to the number of breeds of sire evaluated, not in proportion to n(n-1) different crosses, counting reciprocals. This means that one can include more breeds in a given testing program without as prohibitive increases in total size of the experiment. In figure 5 the standard error of a mean difference between two breeds of sire is shown as affected by the number of sires per breed of sire and by total numbers of progeny per breed of sire. The upper (dashed) lines refer to maternal performance for the heritability of 20% and coefficient of variation 20% and three records per female. The lower lines refer to a trait such as weaning weight with 30% heritability and a 10% coefficient of variation and a single observation per individual. Notice in both cases that increasing total numbers of progeny per breed of sire reduces the standard error of the mean difference very slowly as compared to increasing number of sire progenies per breed. Note that reduction of the standard error for the mean difference to 2%, which corresponds to detecting a 5% difference with a probability equal to or less than .01, would require twenty sire progenies of eight females each for maternal performance but only about five sires with eight progeny each for individual performance. It is clear that adequate and representative sampling of sires from the breeds under test is of critical importance, and also that pooling of data from different stations will be required if the parameters are to be estimated with a desired degree of precision, particularly for some of more highly variable and less heritable traits.

In the two-way table of F_1 crosses, breed of dam effects, of course, contain both the transmitted and the direct maternal influences on the progeny including epistatic and inbreeding level effects. Estimation of maternal effects alone involves subtracting the estimated breed of sire effect from breed of dam effect. This, of course, is the variance of difference between two differences and would have a variance which would be the sum of the two variances for the separate mean differences.

Estimates of the parameters which influence choice of mating system are somewhat more complex. Heterosis of individual performance, of course, is estimated directly by comparing F_1 with parental mean performance. Maternal heterosis plus 1/4 of the potential maximum recombination effects is estimated by the superiority of three-way crosses over the constituent F_1 average. Special designs, of course, can be used to estimate maternal heterosis without confusion with recombination effects as Willham has pointed out. In fact, comparison of the reciprocal three-way crosses will be an estimate of maternal heterosis alone, ignoring sex linked

differences. Estimation of recombination effects or of proportion of heterosis retained in advance generations, requires comparison of the F_3 generation or second generation of inter se mating with the other types of crosses. This will usually involve comparison of crosses not produced in the same year and thus requires a control population from which each kind of cross can be deviated in order to make between year comparisons of different kinds of crosses.

Formula for mating system differences:

$$
\begin{aligned}
\bar{F},-\bar{P} &= h^{I} \\
C(AB),(3\text{-Way}-\bar{F}_1) &= h^{M} + 1/4r^{I} \\
AB(C),(3\text{-Way}-\bar{F}_1) &= 1/4r^{I} \\
C(AB),(3\text{-Way}-\bar{F}_3) &= 1/2(h^{I}+h^{M}) \quad -1/4r^{I}-1/2r^{M}
\end{aligned}
$$

Estimation of expected standard errors is more complex and the standard errors are not the same for different parameters but again it is reasonably certain that combining of evidence from different experiments will be necessary to achieve reasonable precision in the estimates. When purebred populations of the breeds being evaluated are included in the experiment the design for estimating both average breed of sire effects and the heterosis recombination parameters is really straight forward and does not involve back crosses. However, when some of the breeds evaluated are imported and only sires are obtained, several breeds may be used as tester or reference breeds for evaluating them in comparison with the breeds represented only by sires (figures 6 and 7). In the latter case back crosses to the imported breed will be required to approximate the parameters of the imported pure breed itself.

Steps in evaluating breeds and methods.

As an outline summary one might follow the steps indicated below in evaluating some of the more promising breeds in a particular class of livestock.

STEPS IN EVALUATING BREEDS AND METHODS

I. Define objectives
   A. Relative economic importance of traits
   B. Consumer preferences-market
   C. Sources of variable costs
   D. Probable future management systems

II. Select management conditions
   A. Minimize production costs
   B. Maximize product acceptance

III. Select breeds and methods of use
   A. Screen breeds--existing information
   B. Assemble promising breeds
      1. Adequate sample
      2. Quarantine problems
      3. Sires only?

C. Compare pure breeds under defined objectives and conditions, i.e. Classify as "sire" or "dam" breeds for crossing
D. Compare F_1's and P_1's for best breeds
   1. Separate transmitted, maternal effects
   2. Choose sire-dam breeds
E. Compare 3-breed crosses
   2 or 3 sire breeds x all F_1 females of 6-8 breeds
F. Produce F_2, F_3 for only crosses of best 3 or 4 breeds
   1. F_3 for best 2 sire breeds, 2 dam breeds
   2. F_3 for best 4 breeds (ABxCD)

Reference

Dickerson, G.E. 1969. Experimental approaches in utilizing breed resources. ABA 37:191.

FIGURE 1

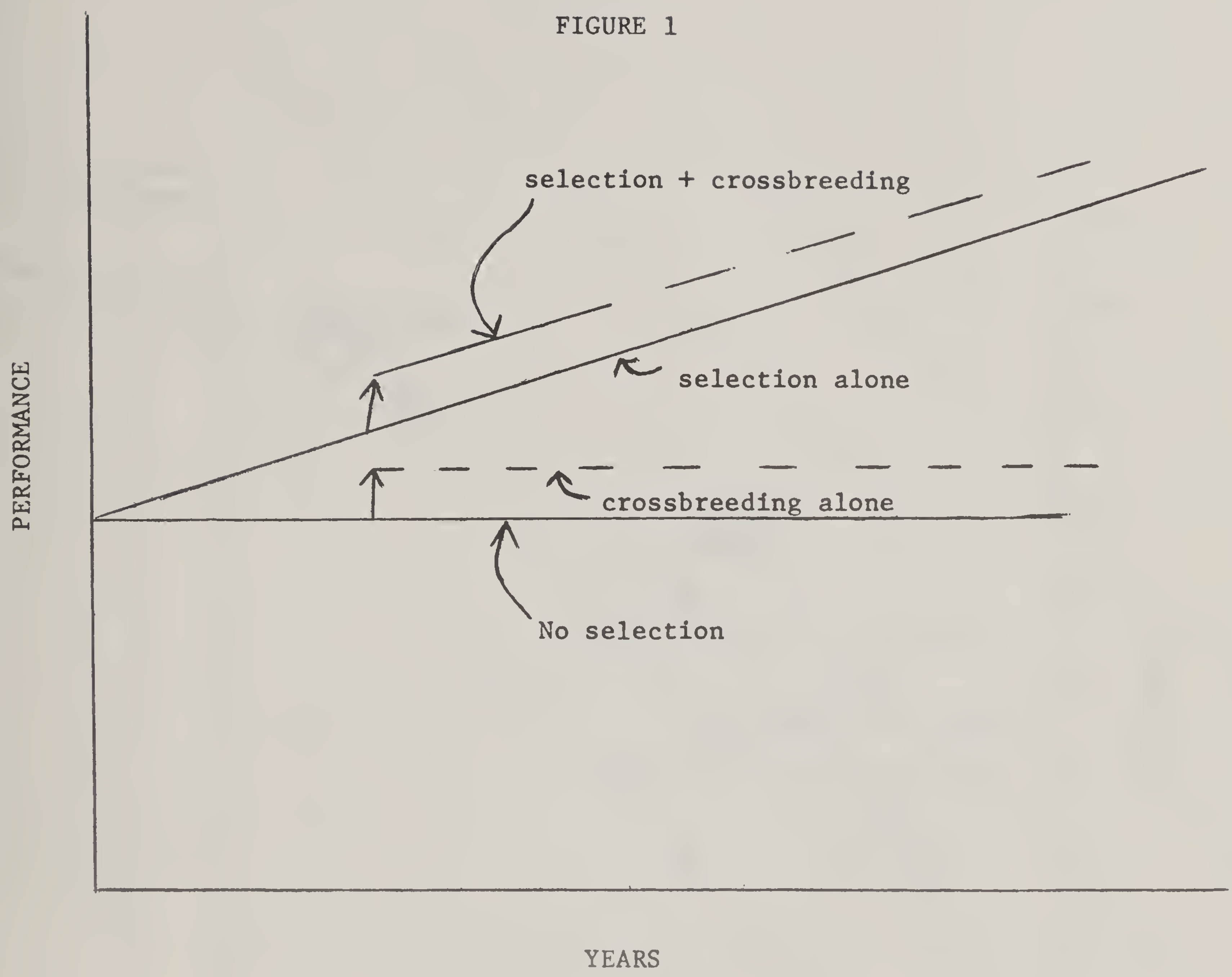

selection + crossbreeding
selection alone
crossbreeding alone
No selection
PERFORMANCE
YEARS

FIGURE 2

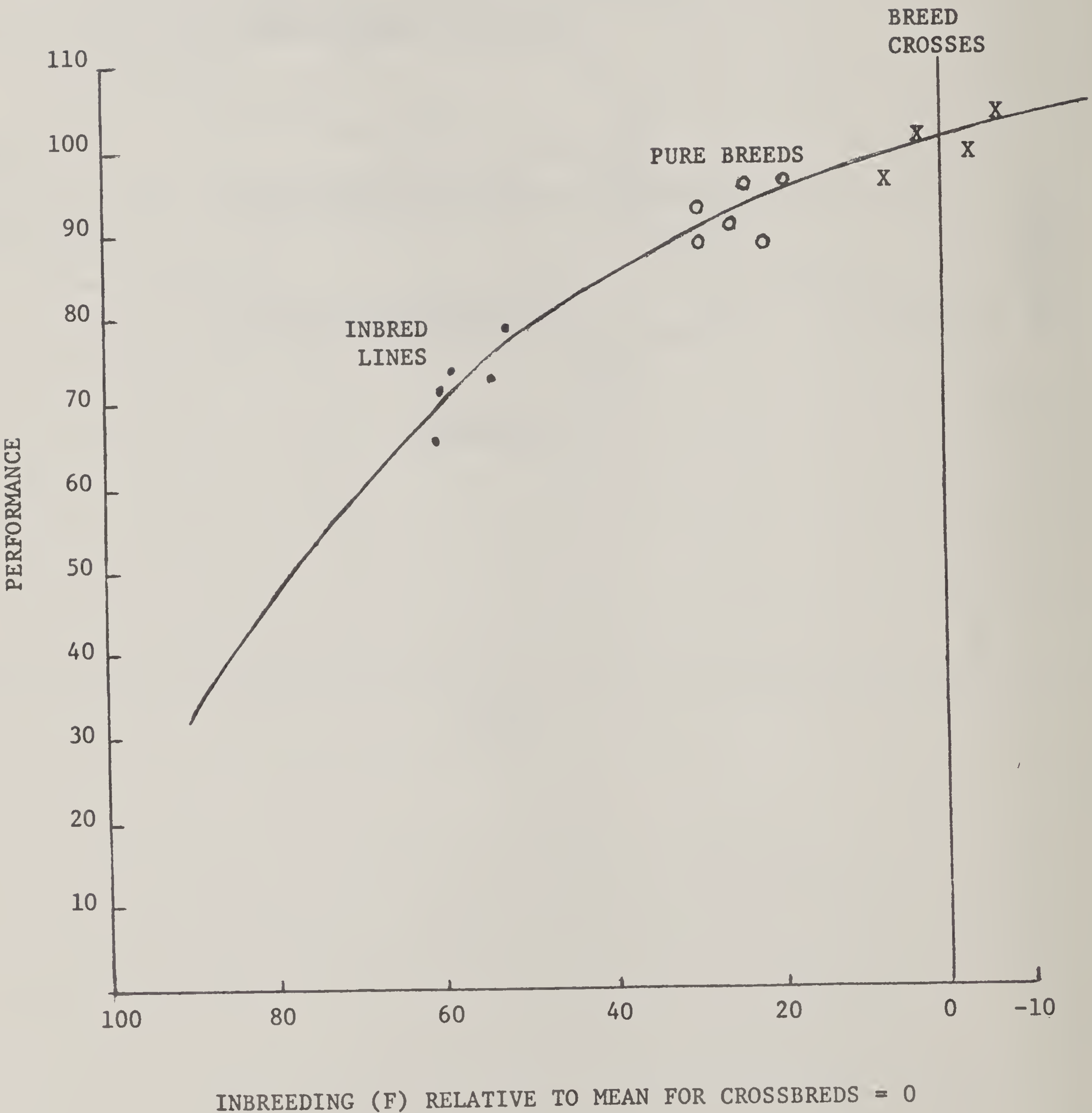

BREED
CROSSES
PURE BREEDS
INBRED
LINES
PERFORMANCE
110
100
90
80
70
60
50
40
30
20
10
100
80
60
40
20
0
-10
INBREEDING (F) RELATIVE TO MEAN FOR CROSSBREDS = 0

FIGURE 3

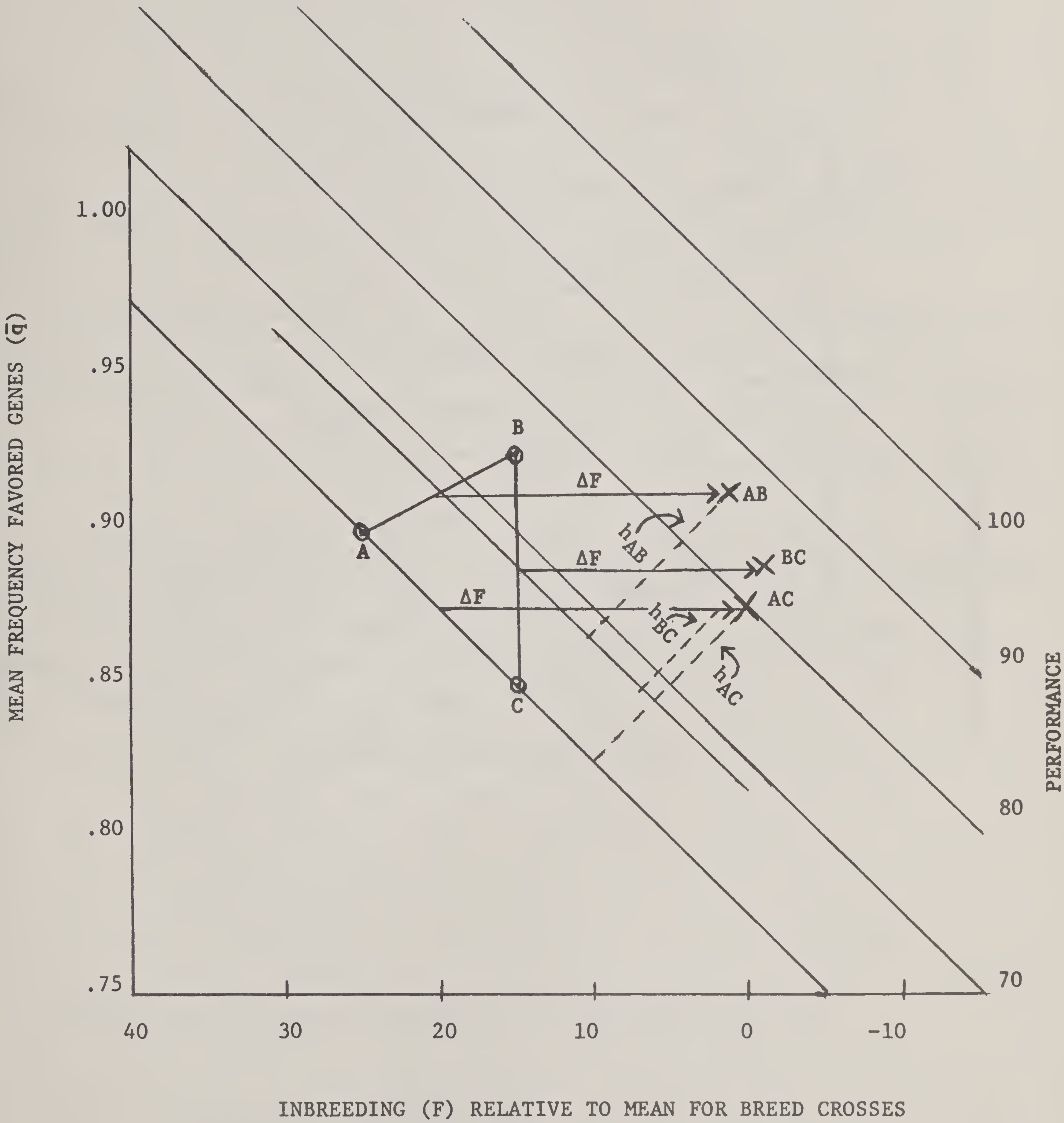

1.00
.95
.90
.85
.80
.75
MEAN FREQUENCY FAVORED GENES ($\bar{q}$)
B
A
C
ΔF
ΔF
ΔF
AB
BC
AC
h_{AB}
h_{BC}
h_{AC}
100
90
80
70
PERFORMANCE
40
30
20
10
0
-10
INBREEDING (F) RELATIVE TO MEAN FOR BREED CROSSES

FIGURE 4

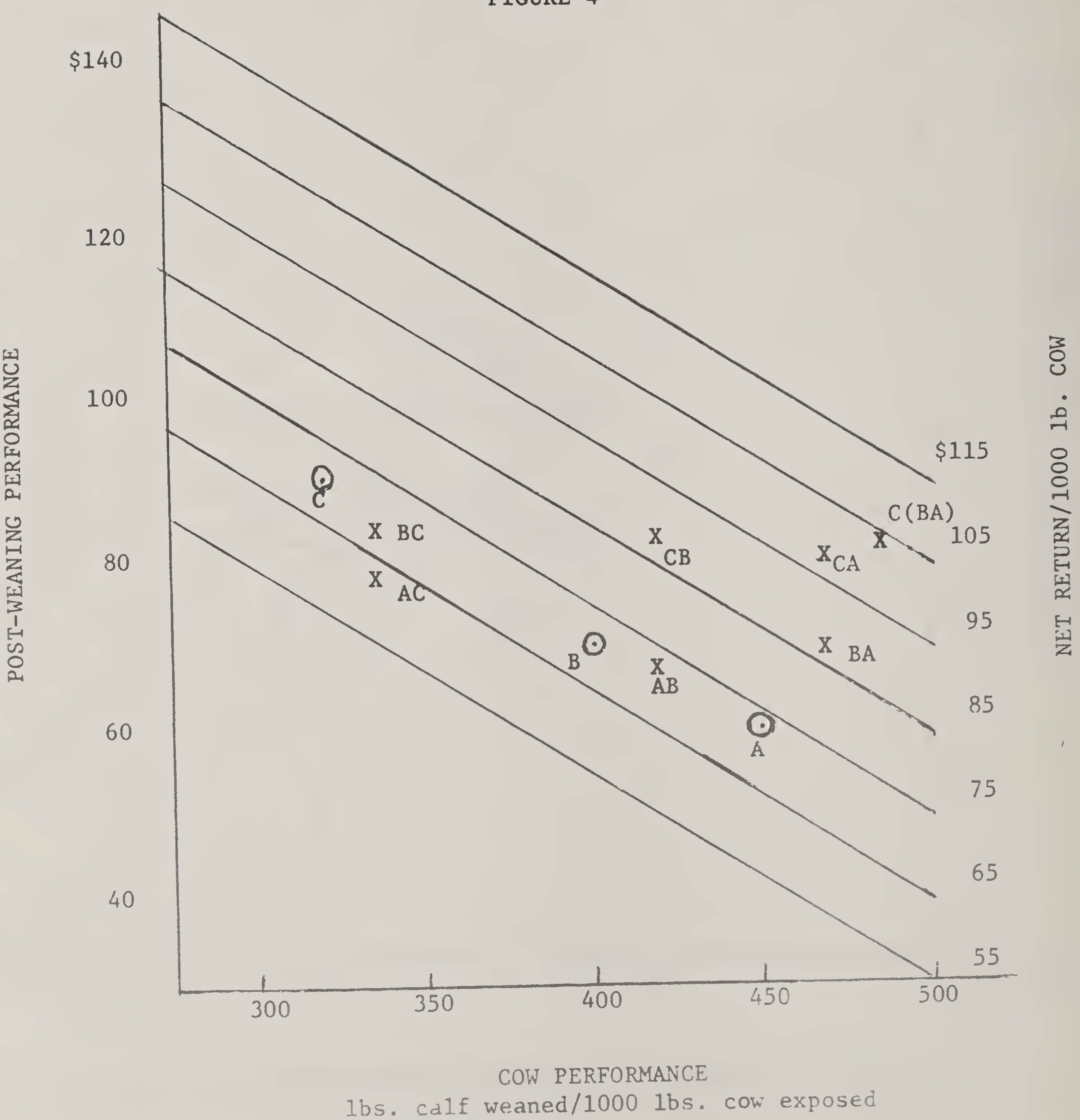

$140
120
100
80
60
40
POST-WEANING PERFORMANCE
$115
105
95
85
75
65
55
NET RETURN/1000 lb. COW
C
X BC
X AC
B
X CB
X AB
A
X CA
X BA
C(BA)
300
350
400
450
500
COW PERFORMANCE
lbs. calf weaned/1000 lbs. cow exposed

FIGURE 5

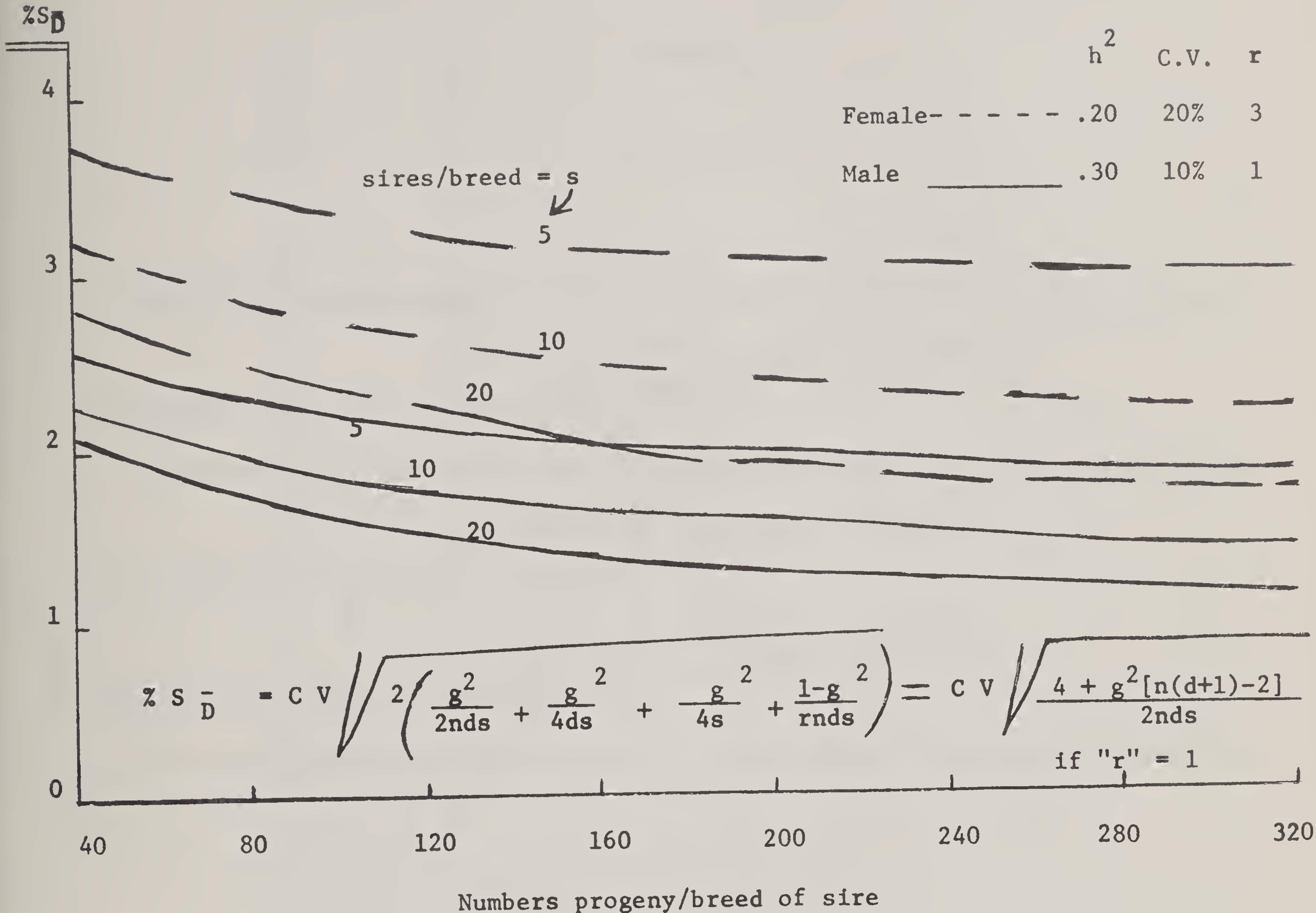

%S$_{\bar{D}}$
4
3
2
1
0
h^2 C.V. r
Female- - - - - - .20 20% 3
Male ________ .30 10% 1
sires/breed = s
5
10
20
5
10
20
$\% S_{\bar{D}} = C V \sqrt{2\left(\frac{g^2}{2nds} + \frac{g}{4ds}^2 + \frac{g}{4s}^2 + \frac{1-g}{rnds}^2\right)} = C V \sqrt{\frac{4 + g^2[n(d+1)-2]}{2nds}}$
if "r" = 1
40
80
120
160
200
240
280
320
Numbers progeny/breed of sire

FIGURE 6

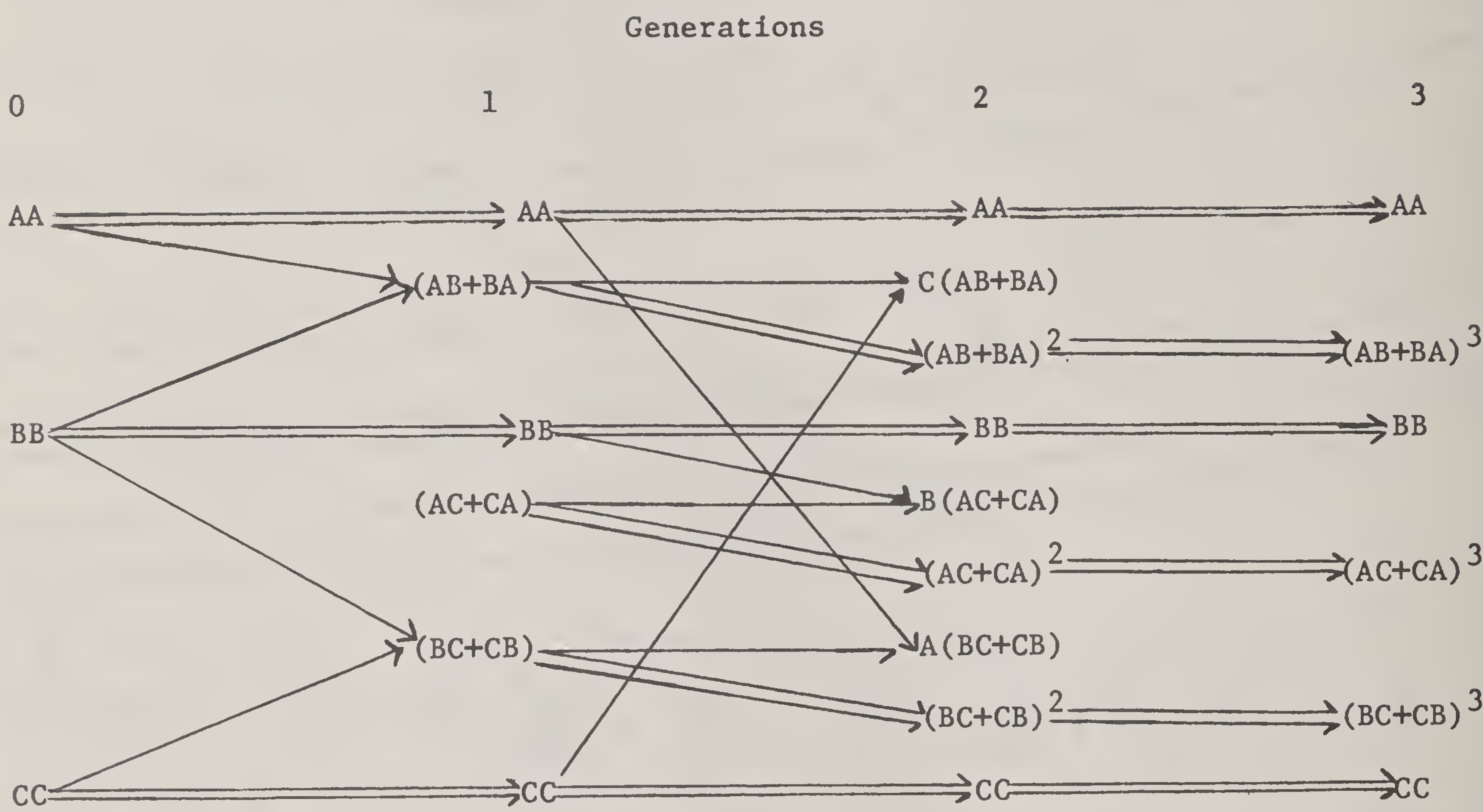
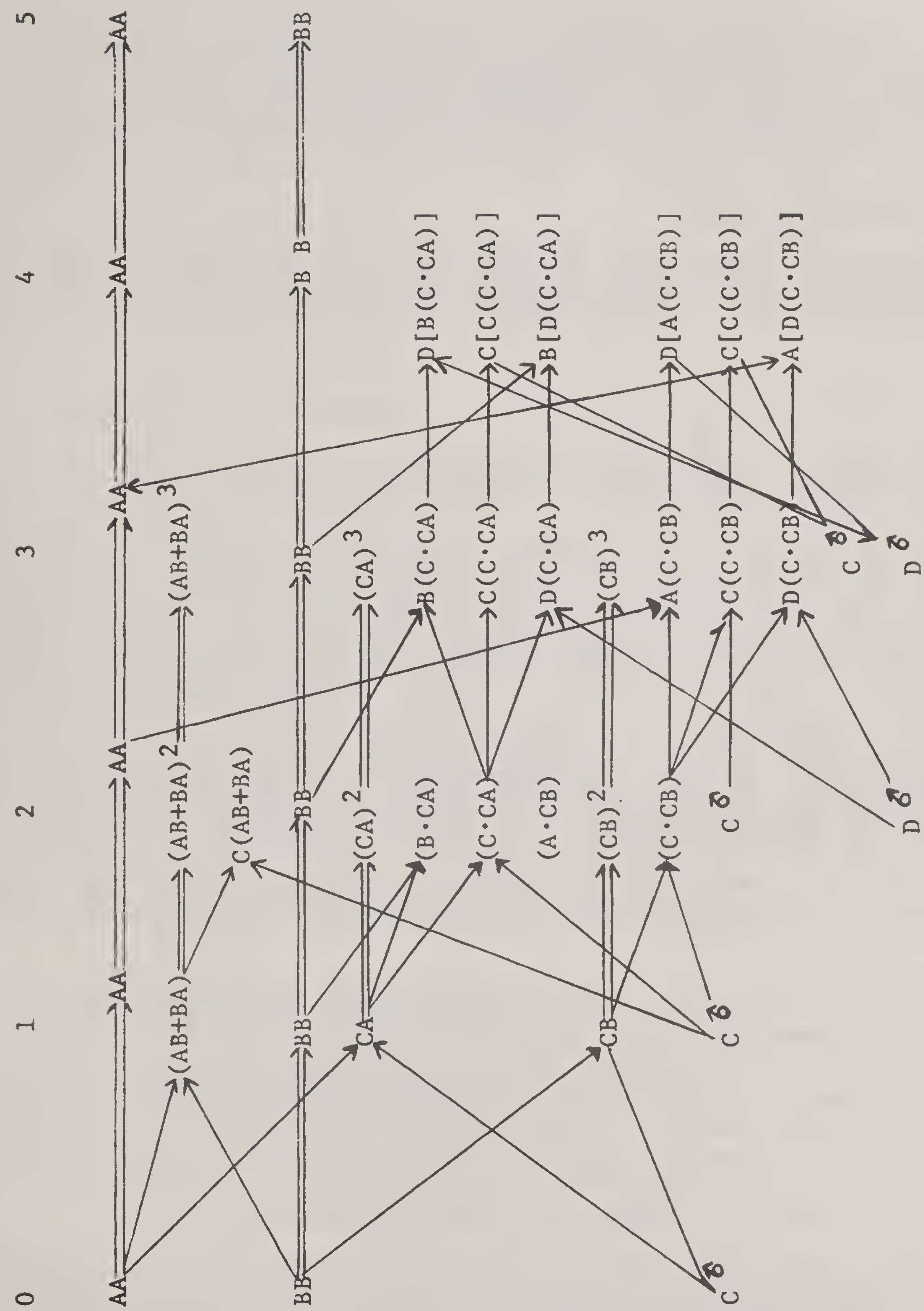

Generations
0
1
2
3
AA
BB
CC
AA
(AB+BA)
BB
(AC+CA)
(BC+CB)
CC
AA
C(AB+BA)
(AB+BA)^2
BB
B(AC+CA)
(AC+CA)^2
A(BC+CB)
(BC+CB)^2
CC
AA
(AB+BA)^3
BB
(AC+CA)^3
(BC+CB)^3
CC

Figure 7

Generations



PROGRAMS TO UTILIZE BREED DIFFERENCES*

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The role of beef breeding research, its adequacy and its potential direction, have been examined in some detail by previous speakers and more is yet to be said regarding some of the programs now underway. At this point it seems appropriate to consider some aspects of industry application of the knowledge to be derived from this research, with particular reference to the industry structure which might evolve over the next 20 years.

Interest in the topic has been focused rather sharply by the change in the breed importation policies of this continent. The new genetic material now becoming available will see industry application in four ways:

(1) crossbreeding
(2) development of new breeds
(3) propagation of the imported breeds
(4) promoting competitive improvement of existing breeds

Advice of research people will be sought initially in the matter of breed choices for importation but hand in hand will come questions on the most effective procedures for utilizing the new breeds. At this point in time we have relatively little guidance to offer on either question. Breed differences are hard to gauge due in part to the extreme difference between European and American conditions and in part to the nature of the records available in Europe. Advice regarding potential application is equally hazardous. It is clear, however, that semen from all imported bulls will be preserved and widely disseminated for A.I. use. For the next decade at least, producers will be less concerned about following research projections than with exploiting the new and unproven. (It has been suggested that there is never an appropriate time to confuse the real issues with facts.) For this reason the paucity of current knowledge is not a serious liability provided we move with reasonable speed and sureness to secure the information that will be required by the industry in the 1980's.

This,of course, is a large order. Before we can effectively discuss the utilization of breed differences we must attempt to define the performance traits of importance and rank them in terms of relative economic importance. From this foundation it might be possible to extrapolate to procedures for industry application. The first part of this presentation will consider some components of net productivity. The second part will attempt to integrate this material in terms of industry applicatior

Part I. Components of Net Productivity

One measure of net performance is the lifetime production (pounds of calf weaned) of a brood cow. This will be a function of age at first calving, duration and regularity of reproductive life, and pre-weaning growth of her progeny. The

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*Prepared for Joint Meeting, Regional Beef Cattle Breeding Technical Committees, U. S. Meat Animal Research Center, Clay Center, Nebraska, August 11, 1970.

latter will reflect both milk production of the dam and genetic growth potential of the calf. To rank these components in terms of relative importance it is useful to examine the influence of each on production costs. These include feed, labor, veterinary supplies and services, management skills, and the capital overhead of facilities, land and equipment. Each of these costs is highly influenced by environmental conditions, geographic location and management decisions. And to a certain extent each is conditioned by the environmental requirements of the chosen genotype or, conversely, by the economic consequences when such requirements are ignored. However, apart from tailoring genotypes to fit specific environmental niches, the primary production cost to be considered in genetic improvement is that of feed.

Critical research data bearing on the variables influencing feed requirements are limited but the topic can be explored by utilizing the N.R.C. standards for recommended nutrient requirements (3). One limitation to this approach is the feasibility of restricting feed intake to requirements. This point will be reconsidered later.

D.E. requirements for calf production

Total feed inputs required for a 1000-pound range cow, calving initially at 3 years of age, producing 11 pounds of milk daily during nursing, and weaning her fifth calf at 8 1/2 years of age for a life time production of 2000 pounds of calf (5 x 400 lb) may be considered as a base (100%) with which alternatives are compared. This production pattern requires a life time feed input of 44,053 M cal or, in terms of calf production, the equivalent of 14.2 pound of barley for every pound of calf weaned. Note that 19.5% of this feed charge would be required to carry the breeding female to her first calving and 9.9% would be an input to sustain lactation.

Net efficiency can be improved by decreasing the feed inputs prior to breeding and/or by increasing pre-weaning growth rate of the calves. Some examples of relative efficiency with costs expressed as a percentage of the basis charge defined in the preceding paragraph are as follows (all examples derived from Table 1).

1. More milk, producing a 500# calf at weaning
   5 x 500 = 2500# of calf — 90.8%

2. Breeding to calve at 2 years
   6 x 400 = 2400# of calf — 89.7%

3. Calving at 2 years, more milk
   6 x 500 = 3000# of calf — 82.7%

4. Calving at 2 years, more milk, extra growth rate
   6 x 600 = 3600# of calf (not shown in table) — 68.8%

Assumptions made in respect of the relationship between milk production of the dam and weaning weight of the calf are derived from research reported by Berg et al, (1967, 1970), and feed requirements for milk production are calculated according to N.R.C. recommendations for dairy cattle.

Providing winter shelter for the brood cow reduces the maintenance inputs by about 17% (Webster, 1970) but this represents only about a 2.5% reduction of the life time feed budget.

Large cows--1300 pounds at maturity--have increased maintenance requirements and may be competitive with example 4 above only if they regularly wean calves substantially heavier than 600 pounds (e.g. A 1300 pound cow weaning 6 calves at 600 pounds each is estimated to have a relatively efficiency of 80.9%).

Substantial savings in maintenance requirements might be effected by dry lot management of the brood cow. Webster (1970) has postulated savings approaching 50% although this may require downward revision.[1] The economics of such savings would have to be appraised in relation to changes in the costs of facilities and labor.

The association between longevity--specifically number of uninterrupted calvings--and D.E. inputs per unit weight of calf weaned is illustrated by the 4 upper curves of Figure 1. A sharp decline occurs to about the third gestation but little further improvement occurs after the fifth gestation. Reproductive failure or pre-weaning loss of a calf would markedly increase the net requirements.

Also shown are curves (Nos. 5 and 6) depicting the D.E. inputs required per pound of live animal produced (calf weaned and cow sold to slaughter) at the termination of the first, second or later gestation. Note that for these curves as for the other curves of Figure 1, the calculation of cow feed costs commences with the female selected at weaning. Restricting production to a single gestation with the dam fattened immediately for slaughter (at an assumed D.E. input of 2000 M cal) at 1000 pound weight results in the lowest D.E. costs. These costs rise slowly with each additional gestation prior to slaughter of the dam. It should be noted that the upper (4) curves in the figure relate only to pounds of calf weaned whereas the two lower curves incorporate the post-weaning gain of the dam. Including salvage value of the dam in the upper curves would shift them down and curves 3 and 4 would merge with curves 5 and 6 respectively at the extreme right of the figure.

The two lower curves of Figure 1 indicate that feeding the cow for slaughter immediately following production of her first calf (i.e. rearing the calf artificially or on other cows) would give a further slight improvement in net D.E. efficiency. Rearing the calf from birth to 400 pounds would require D.E. inputs of approximately 1380 M cal (Dairy cattle standards). Feeding the dam to gain approximately 150 pounds over two months would require 2000 M cal. These inputs added to the 10,000 M cal required to rear the dam from weaning to the end of her first gestation (2 years of age) sum to 13,380 M cal to produce 1000 pounds of market product (1 calf at 400 pounds and 600-pound gain for the dam).

Placed in a monetary context, barley at 2¢ per pound would equate to 1.3¢ per M cal. For gestation 1 of the curves in Figure 1 this means a feed cost per pound of weaned calf as 17.9, 18.2 and 23.6 cents for curves 6, 5 and 4 respectively.

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[1]Webster (1970) estimates the daily energy expenditure of an 1100 pound cow as 10,900 K cal if housed and 16,190 if on free range (i.e. an increase of 48.5% for walking and grazing). These figures, considered in relation to the NRC estimates of 15,200 and 17,640 K cal daily for maintenance of the dairy and beef cow respectively, indicate an energetic efficiency of 73% under housing and 92% under range conditions. Both figures are exceptionally high suggesting either that the NRC standards are too low or Webster's estimation too high.

For evaluating the relative economic merits of these alternate forms of the cow-calf operation, comparative D.E. inputs and relative costs of alternate D.E. sources do not provide a complete picture. Of rather crucial importance is the question of whether appetite at each production stage can be (or should be) tailored to match actual requirements. If such control proves impossible or economically unfeasible, projections based on energy requirements represent an exercise in futility. But granting that such control is possible, there are other economic factors to be considered.

1. Relative economic value of a young versus an aged cow.

2. Relative cost of facilities (important in the case of artificial rearing of the calf and also important if special feeding practices are required to ensure feed intake in accordance with requirements rather than appetite).

3. Availability and dollar cost of replacement heifers. Slaughter of all females following birth (or weaning) of their first calf would mean annual replacement of all cows in the herd. The implication of this requirement (e.g. with a 50-50 sex ratio this would mean the marketing of two females, one cow and one heifer calf, for every male produced) suggests that the practice would be totally impractical unless multiple births and/or sex control become practical realities.

4. The logistics of annual replacement of all proven reproductive units with heifers of unknown and untried potential. Conception rate might be of minor importance since pregnancy testing would permit early marketing of non-pregnant females. However, the economic implication of such culling is obviously dependent on the relative values of replacement heifers and slaughter cattle.

5. The greater incidence of calving difficulties among heifers, and the lower lactation and hence lighter weaned calf weights characteristic of first lactations. The latter point would not apply if calves were reared artificially.

Most of these factors tend to weaken the economic argument for termination of reproduction after a single lactation. Thus the cow-calf operation is likely to continue in the present production pattern for some time to come. For this reason the industry will be interested in small brood cows, maturing at 1000 pounds or less, capable of producing abundant milk and weaning large calves annually from the age of two years. Such cows would require extra management during lactation; under range conditions they would be unlikely to have the opportunity or capacity to consume D.E. sufficient to lactate and simultaneously maintain a condition adequate for reproduction and/or winter survival. Failure to wean a calf in any year would markedly increase the production costs.

Among the implications in this definition of the "ideal" brood female is the fact that any breeding program designed to produce her will inevitably produce cull females and males with a comparable growth rate and mature size.[2] To appraise the

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[2]Successful techniques for sex control, or incorporation of genes which produce sex dimorphism in respect of growth rate would permit modification of this statement.

economic consequences of this fact requires an examination of the energy inputs required for rearing cattle to market weight.

D.E. requirements for feed lot gains

Three variables influencing the total D.E. requirements for feed lot gains are:

1. Weight of calf at start of feeding; light calves will be longer in the feed lot and thus will incur higher maintenance charges.

2. Rate of growth permitted during the initial part of the feeding period; the more rapid the growth the lower the maintenance charges.

3. Final market weight; light terminal weights will result in lower feed requirements for both maintenance and gain.

It is obvious that maximum efficiency in D.E. utilization is not necessarily equivalent to maximum profitability. The latter will depend on the relative costs of different D.E. sources (e.g. energy derived from barley grain would cost approximately 25% more than energy derived from brome hay) and the relationship between market value and terminal weight and/or degree of fat cover on the carcass. But considering only the question of D.E. inputs, the most efficient conversion is achieved by minimizing maintenance charges--a combination of light initial weight, maximum growth rate and a relatively light terminal weight. Thus a steer placed on feed at 400 pounds and marketed at 1000 pounds by 13 months could produce each unit of live weight gain at a cost of 5.8 units of barley. Alternatively, a 600 pound steer fed to the same terminal weight at 11 months would require approximately 5% more feed (6.4 units of barley) per unit of live gain. At a terminal weight of 1200 pounds the difference in feed requirements increases to approximately 6%.

The 200 pound difference in 180 day weaning weight represents a difference of 33% in pre-weaning growth. If this difference carries forward, the figures for a 400 pound calf gaining 3 pounds per day should be compared with a 600 pound calf gaining 4.5 pounds per day. The latter would then require 5.5 pounds per pound of gain to 1000 pounds, or an improvement of approximately 5% over the slower gaining calf. Further, if feed requirements are a function of age rather than weight for these youthful cattle, the advantage of the rapid gainer would increase to 18%. (4.8 units of barley per unit of gain).

Two points of importance to the beef industry are illustrated by comparison of Tables 1 and 2. First is the fact that the feed inputs involved in producing a weaned calf are substantially larger than those required to carry the calf from weaning to slaughter weight (barley equivalents of 9.8 versus 4.8 for the two most efficient examples of pre- and post-weaning growth from the two tables. This reinforces the early conclusion regarding the importance of minimizing D.E. inputs for weaned calf production. Second, heavy calves at weaning, a requisite to minimizing pre-weaning D.E. charges, will be most profitable in the feed lot provided that their superiority in pre-weaning daily gain carries forward into the feed lot. This advantage will be particularly marked if their younger age at the terminal market weight means a leaner carcass.

The estimates of Table 2 indicate the need for considering the total economic implications associated with production of the "ideal" small brood. However inferior growth rate is not a prerequisite to light mature weight (i.e. 1000 pounds). Specific breed crosses may offer a useful method for combining rapid growth with minimum mature weight.

D.E. requirements in relation to lean content of the carcass

Marketing decisions are based on many factors but of paramount importance is the desire to achieve the market weight and grade commanding above average prices. Insofar as North American markets are concerned these criteria generally specify market steers or heifers (not bulls) in the live weight range 950 to 1150 pounds and carrying above average fat cover. Implications of these criteria in respect of D.E. utilization are indicated by the data of Table 3 (adapted from Fredeen, 1970).

Lean content of the carcass (expressed as a percent of live weight at slaughter to accommodate the direct relationship between dressing percentage and carcass fat) decreases with increasing fat cover. Bulls yield more lean and heifers less than steers of the same average rib fat (e.g. at 0.7" average fat averages for percent yield of lean were 31.1, 28.2 and 29.8 for bulls, heifers and steers). Feed figures were not available for heifers but the D.E. required pe r unit of live gain would undoubtedly follow the same trend as for bulls and steers, increasing with increasing fat cover. With sexes compared on an equal rib fat basis bulls were approximately 25% more efficient than steers in D.E. conversion to lean. (Barley equivalent per unit live gain with the comparison made for average rib fat of 0.5" was 7.46 for steers and 5.18 for bulls). This reflects the combination of more rapid gains and higher lean content.

The data of Table 3 clearly demonstrate the potential economic advantages to be derived by minimizing fat production and by feeding entire males rather than steers for slaughter. The fact that these specifications are contrary to the "best beef" image currently promoted by the retail trade should be a matter of grave concern to the beef industry.

Part II. Industry Application

The upward trend in consumer preference for beef has created great optimism in the beef industry. Beef prices have not declined in spite of increasing prices--it is estimated that 75% of the consumer meat dollar is spent on beef--and increasing per capita demand coupled with increasing population size has encouraged some amazing projections for the beef production required in the relatively near future.

Perhaps the projections are correct, but we must not ignore the fact that they are based on the exceedingly fragile foundation of consumer demand. People have no unalterable convictions and the present infatuation with beef probably should be viewed as a testimonial to the consistency and persistency of retail promotion over the past several decades rather than growing allegiance to the product. Unless the beef industry moves soon to establish a strong competitive position producers may be reminded forcibly that there are alternate meat products including the so-called protein extenders.

This statement applies to the entire industry, not to producers alone. Indeed some major contributions to inefficiency occur in the merchandizing procedure. Further, traditional product specifications, entrenched in carcass grading procedures

and vigorously protected by vested interests of the retail trade, have discouraged the development of tangible economic incentives for lean meat production. But these aspects of the industry are changing and the onus is on the producer to evolve production techniques that will improve the competitive position of beef relative to other meats.

The material of Part I provides some guidance on specifications for the productive unit--brood cow and weaned calf--that will maximize production per unit of feed input. These specifications are:

1. Brood cows
   - producing their first calf at 2 years of age.
   - capable of uninterrupted reproduction and calf production to weaning as long as they remain in the herd. Longevity (beyond 6 1/2 years) is of secondary importance.
   - capable of producing abundant milk.
   - producing calves with rapid growth and high weaning weights.
   - maturing at a weight of approximately 1000 pounds.

2. Weaned calves
   - that reach the desired market weight at a minimum age.
   - that are physiologically young at the chosen market weight to minimize fat content.
   - that possess abundant muscling.

None of our existing breeds meet all of these specifications. Further, the reproductive advantages of hybrid heifers (earlier puberty and higher conception at first service) coupled with the opportunity afforded by crossbreeding for combining in one animal the desired traits of two or more breeds support the view that hybrids, not straightbreds, will be the brood cows of the future. The calves they produce will in turn represent another cross with the top cross bull breed chosen in accordance with the characteristics required for specific markets. Growth rate, carcass muscling and physiologic age at a designated market weight (as a control on the degree of fatness) will be primary considerations.

Development of demand for hybrid breeding stock would support the following industry structure:

1. Selective propagation of foundation (straightbred) lines designed for producing F_1 hybrid females and top cross sires. (The lines may be breeds or synthetic lines).

2. Large scale production of hybrid females for breeding use (may be combined with foundation herd operations.)

3. Commercial production based on hybrid females.

This projection of industry structure is not new and logistics concerning its application may be deduced from experiences with poultry and pigs. From these experiences we can also conclude that the successful seed stock enterprises will involve large herds of breeding females which, if not singly owned, are under single direction in respect of selection and breeding decisions. (This, of course,

is the direction indicated by population genetics theory and proven by practical experience.) Similarly, enterprises geared to the production of hybrid females must be of sufficient size to guarantee continuous supplies of quality stock in such quantities (and at prices) that can support effective sales promotion. It is almost certain that those who merchandize hybrid females will seek to establish complete control of the foundation lines involved.

The basic breeding research required for effective advancement of this industry structure has already been done. What remains is research documentation of the specific role which may be played by established and, as they become available, the foreign breeds. Public (i.e. tax supported) research may make a relatively small contribution to this documentation; limited research resources will hamper investigations of the potential multitude of breed crosses and/or environmental circumstances. Further, the industry will not be content to wait for the outputs from planned research. Instead producers will make commitments to breed combinations well in advance of--and often in spite of--research evidence. Having made their moves the time and cost involved in switching from a known quantity for which markets have been developed to possibly superior but unknown products will serve as a strong deterrent.

However, industry will assume a commanding position in new breed and breed cross evaluation (as an example consider the Conception to Consumer progeny testing program of the Canadian Charolais Association which has now been broadened to include the Simmental) and trained animal breeders will be challenged to provide guidance on the design of effective testing programs and the interpretation of results. It is in the training of these technical advisors that beef cattle research will play its most vital role. Research with laboratory species or with poultry or pigs will be a useful supplement but nothing can replace a thorough exposure to the problems of beef cattle husbandry.

Does the future for beef breeding research hold nothing more demanding than the training of industry advisors? Are there no major scientific contributions to be made? Before considering this second question the record of research in animal breeding should be examined. Over the past 40 years such research has had a profound impact on poultry breeding and contributed substantially to pig breeding practices. A large body of evidence directly applicable to the beef industry has also been developed. But the beef industry, hampered by the slow reproductive rate of their species and inhibited by tradition, has been exceedingly reluctant to support genetic research or to accept the new breeding and selection technology.

The situation has changed dramatically in the past 5 years. Beef breeding research is now front center of the stage with other species occupying the wings. This shift in fortunes should serve to remind us that beef breeding research is also expendible. Today's society is preoccupied with finding solutions to crises. Once a crisis has passed those who found and applied the solution are forgotten in the rush to deal with another crisis. In short, the reward for success is obscurity. Relative obscurity has been the reward granted poultry and pig research programs; in time it will be the reward granted beef cattle research. The current fever of interest in beef cattle breeding is a transient phenomenon. While it lasts, research agencies will be exhorted to open doors to importation of all possible genetic material, to produce quantities of technical information regarding optimum breed combinations and to update the research evidence on crossbreeding systems. And when it subsides, beef cattle research will be shuffled into the wings while another performance--perhaps the development of meat substitutes--moves forward to dominate the scene.

Now, while interest runs high, is the opportunity to develop strong research facilities and programs for beef cattle research. The new breeds being imported bring with them new dimensions of performance in growth rate, mature size, lactation potential and muscling. To document even a modest amount of information on effective ways for incorporating these features in our beef industry will occupy much of our research resources during the decade ahead. We cannot side step this obligation. The questions being raised by beef producers are entirely pertinent and until industry is in a position to secure this information by other means, research institutions must fill the void. But in this process, the overall research plan must be aimed beyond the immediate horizon of crossbreeding. We do not as yet have solid answers on many of the basic issues in beef cattle production. A few examples with implications to the animal breeder are:

- Energetic efficiency in the transformation of digestible energy and/or protein to edible product, a process that must start with the rearing of the replacement female and ends with the retail product. Perhaps it is well to re-emphasize here the fact that feed requirements and feed consumed are not synonymous. The unknown is appetite which generally will exceed functional requirements. Research has yet to secure an answer to the question of optimum procedures for measuring feed "efficiency", or to untangle the genetic implications of adopting results obtained from one versus another of the several feed efficiency criteria now available.

- Effective, reliable and practical performance evaluation techniques and procedures. This embraces the securing of methodology for live animal evaluation, defining and quantifying environmental inputs to observed differences, and development of appropriate selection procedures.

- The possibilities for improved reproductive performance and the genetic aspects of response to estrus control, superovulation, and other techniques for manipulating reproductive potential.

- Procedures for exploiting special genetic situations such as muscular hypertrophy and the possibility of developing special purpose lines with a high response to physiological manipulation (e.g. exceptional muscular development following androgen therapy).

- Relative response of different lines and/or crosses to intensive management (confinement).

- Conversely, the relative response of different lines to low intensity management, specifically the question of converting coarse feeds (by products of cereal grain production) instead of the high energy grain itself.

- A closer examination of the relative economic merits of specific 3-way crossing (as outlined here) and rotational cross breeding. It is certain that the latter will be used extensively by the industry, in fact it along with straight breeding, single crossing and back crossing will probably continue to supply most of the commercial slaughter cattle for the next several decades.

These few examples have not been listed with any thought to relative importance. They are cited only to support the optimistic view that beef breeding research is still in its infancy with a long and productive life ahead. The present climate is favorable, and programs designed to focus on these kind of issues will continue to bear fruit years after the current activity with new breeds and crosses has been woven into industry practice.

One other area may offer a special challenge to the animal breeder. Each of the new breed societies (Charolais, Simmental, Limousin) have provided for the recordation of first crosses. This is a logical decision in view of the scarcity of imported females and the relative abundance of new breed semen. Societies representing the long established breeds have not been oblivious to the challenges posed by the new breeds and several have reacted by opening their herd books to permit entry of the glamorous foreign blood. The consequences are reasonably predictable; the so-called pure breeds will become genetic mixtures and, depending on how rapidly the integration proceeds, the breeds for which we document breed and breed cross data today will not be the same genetic entities in another 10 or 20 years.

It is clear that our breed societies are taking a realistic approach. The Hereford, if it is to compete with the Simmental, must try to borrow on a permanent basis some of the genes of the Simmental breed. Similarly the Shorthorn and Angus, without marked change in their color and type requirements, will inject Limousin into their breeds. By legalizing this procedure of gene migration the breed societies will combine advancement of their breed with maintenance of breeder integrity.

But this process raises the important question of whether unidirectional selection in all breeds is the most effective mode of beef cattle improvement. Further, we must ask whether this melding of breeds will enhance or detract from the potential for exploiting hybrid vigor. Who will maintain, and in what form, the strains for crossing programs? The last question may be irrelevant. Breed societies, the one force that attempts to define and maintain pedigree barriers, owe their existence to the multitude of small breeders. The latter will be a casualty of research technology; they lack the resources to apply the techniques and breeding programs required to remain a viable part of the seed stock industry. With their passing from the scene, breed societies shorn of their main source of revenue will also cease to exist or will become the refuge of fanciers who are removed from the mainstream of economic responsibility to beef cattle production. At that point in time each main breed, or a synthetic derived therefrom, will have been subdivided into lines maintained by individual large scale seed stock producers.

The development will tend to enhance opportunities for developing distinct lines, each selected toward a somewhat different goal. For this reason the first question--the desirability of unidirectional selection--may also be irrelevant. But the second question concerning future opportunities for exploiting hybrid vigor and the allied question of how best to evolve superior foundation lines for crossing purposes remain unanswered. Time is too short to permit appropriate research with cattle. Instead the answers must be sought from experiences with other livestock species augmented by detailed pilot studies with laboratory animals. To engage in or be associated with such investigations is as pertinent to beef breeding research as investigations with species itself.

One final comment. The animal breeder cannot effectively discharge his responsibilities unless he takes a comprehensive view of the environmental framework--economic and biologic--within which beef production occurs. By the same token, economists, nutritionists and others cannot contribute effectively unless they have some understanding of the biological and genetic constraints that exist with the species. The speed and effectiveness with which all disciplines combine their efforts will have a profound effect on the vigor of the beef industry two decades hence.

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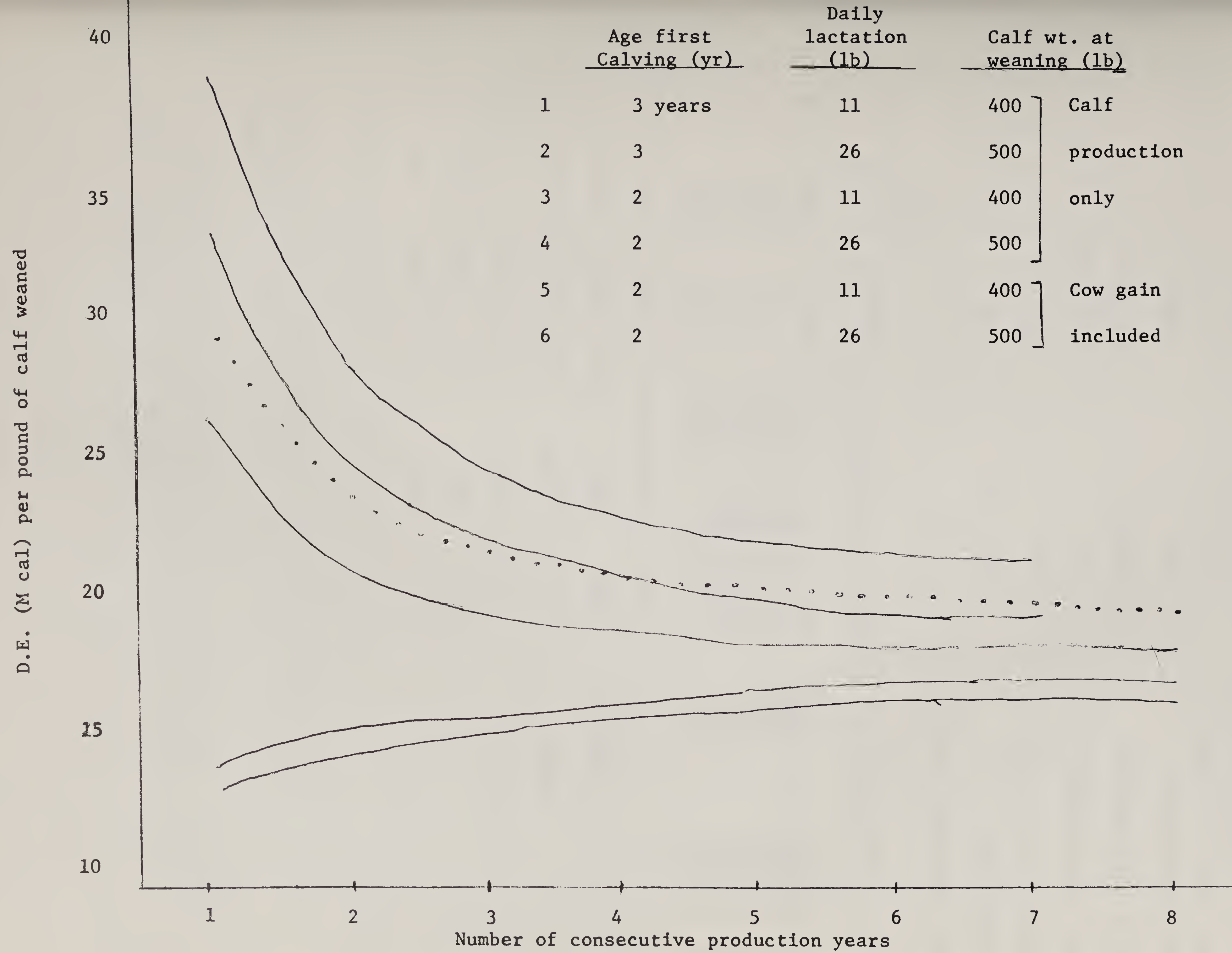

FIGURE 1. Relationship between duration of uninterrupted brood cow production and D.E. inputs per unit weight of calf weaned.

Table 1. Lifetime feed requirements (M cal) for brood cow maintenance and reproduction.

Weaning weight (lb)	400		400		
Age at breeding (mo)	27 months		15 months		
Weight at breeding (lb)	900		900		
Weight at calving (lb)	1000		1000		
Mature weight	1000		1000		
Milk production (lb/day)	11	26	11	26	26 (Winter shelter)
D.E. to first breeding	8593		4880 5238 M cal to calving of first calf		
D.E. to first calf weaned	7092	8280	7092	8280	8084
" " 2nd " "	7092	8280	7092	8280	8084
" " 3rd " "	7092	8280	7092	8280	8084
" " 4th " "	7092	8280	7092	8280	8084
" " 5th " "	7092	8280	7092	8280	8084
" " 6th " "	-	-	7092	8280	8084
Total D.E. to 8 1/2 years	44,053	49,993	47,432	54,560	53,384
Calf size at weaning (lb)	400	500	400	500	500
M cal/lb calf weaned	22.03	20.00	19.76	18.19	17.80
Barley equivalent (lb)	14.21	12.90	12.75	11.73	11.48
% D.E. for milk	9.9	20.9	11.1	19.2	19.6
% D.E. for rearing cow	19.5	17.2	10.3	8.9	9.1

Table 1. (Continued)

Weaning weight (lb)	500			
Age at breeding (mo)	15 months			
Weight at breeding (lb)	900			
Weight at calving (lb)	1000			
Mature weight	1000		1300	
Milk production (lb/day)	11	26	11	26
D.E. to first breeding	5114		5114	
	5238 M cal to calving of first calf			
D.E. to first calf weaned	7092	8280	8841	10060
" " 2nd " "	7092	8280	9071	10290
" " 3rd " "	7092	8280	8571	9790
" " 4th " "	7092	8280	8280	9500
" " 5th " "	7092	8280	8280	9500
" " 6th " "	7092	8280	8280	9500
Total D.E. to 8 1/2 years	47,666	54,794	56,437	63,754
Calf size at weaning (lb)	400	500	400	500
M cal/lb calf weaned	19.86	18.26	23.52	21.25
Barley equivalent (lb)	12.81	11.78	15.17	13.69
% D.E. for milk	11.0	22.9	9.2	19.7
% D.E. for rearing cow	10.7	9.3	9.1	8.0

1 g TDN = 4.4 K cal; 1 lb barley = 1550 K cal; 1 lb brome hay = 1000 K cal; Milk production at 11 lb daily is considered about average for beef cows (Berg and Peschiera, 1967) during the first 120 days of lactation.

Note that annual requirements of 7090 M cal are roughly equivalent to the D.E. production from 2 1/2 acres of barley (30 bush/acre), 2 to 7 acres of brome hay (3000 to 1000 lb/acre) or 12 to 30 acres of short grass pasture (1000 - 300 lb/acre).

Table 2. Energy requirements (M cal) for feed lot finishing of beef cattle weaned at 180 days.

Average daily gain (lb)			1.0		1.5		2.0		3.0		4.5	
Weight (lb) Start	Finish		Maint.	Total	Maint.	Total	Maint.	Total	Maint.	Total	Maint.	Total
400	1000		5980	9340	3988	7348	2989	6349	1993	5353	1315	4675
		Age (mo)	26		19		16		13		10	
	1200		8825	13805	5884	10864	4412	9392	2941	7921	1940	6920
		Age (mo)	33		24		19		15		12	
600	1000		4409	6919	2940	5450	2204	4714	1469	3979	969	3479
		Age (mo)	19		15		13		11		9	
	1200		7254	11384	4836	8966	3627	7757	2417	6547	1594	5724
		Age (mo)	25		20		16		13		11	
600 *	1000		4409	6389	2940	4920	2204	4184	1469	3449	969	2949
	1200		7254	10614	4836	8196	3627	6987	2417	5777	1594	4954
			Total feed inputs (M cal) per pound of gain (barley equivalent in brackets)									
400	1000		15.6 (10.0)		12.2 (8.0)		10.6 (6.9)		9.0 (5.8)		7.8 (5.0)	
	1200		17.3 (11.2)		13.6 (8.8)		11.7 (7.5)		9.9 (6.4)		8.6 (5.5)	
600	1000		17.3 (11.2)		13.6 (8.8)		11.8 (7.5)		9.9 (6.4)		8.7 (5.5)	
	1200		19.0 (12.3)		14.7 (9.5)		13.0 (8.4)		10.9 (7.0)		9.5 (6.2)	
600*	1000		16.0 (10.3)		12.3 (8.0)		10.5 (6.8)		8.6 (5.5)		7.4 (4.8)	
	1200		17.4 (11.2)		13.7 (8.8)		11.6 (7.5)		9.6 (6.2)		8.2 (5.3)	

*These calculations assume that feed requirements for growth only are a function of age not weight.

Table 3. D.E. requirements in relation to composition of body weight gains.

Sex	Av. Rib Fat	Number of Animals	Yield of Lean (%)[a] Av	SE	Days on Test Av	SE
Steers	0.3	4	30.9	.7	107	19
	0.5	29	30.6	.2	135	4
	0.7	63	29.8	.2	145	3
	0.9	47	29.1	.2	156	7
	1.1	16	28.8	.3	158	5
	1.3	9	28.2	.4	185	-
	1.5	-				
Heifers	0.1	-				
	0.3	1	27.2	-		
	0.5	9	29.0	.7		
	0.7	57	28.2	.2		
	0.9	60	28.1	.2		
	1.1	18	27.9	.4		
	1.3	2	26.9	.3		
	1.5	-				
Bulls	0.1	4	35.2	.9	262	22
	0.3	27	33.6	.5	252	8
	0.5	103	31.6	.2	242	4
	0.7	65	31.1	.2	256	6
	0.9	38	30.7	.3	271	6
	1.1	14	30.8	.4	282	7
	1.3	6	30.2	.5	395	10
	1.5	2	28.5	1.0	315	-

Table 3. (Continued)

Sex	Live wt at slaughter (lb) Av	SE	D.E. consumed K cal/day Av	SE	Number[b] of Animals	D.E. per unit lean gained[c] K cal/day Av	SE
Steers	865	12	21.3	2.8	3	26.7	1.2
	920	20	21.9	0.6	15	35.4	3.2
	966	15	22.7	0.6	21	36.1	1.2
	992	14	22.7	0.8	12	36.6	1.5
	983	18	23.8	0.6	9	38.8	0.6
	1123	18	25.7	0.3	6	40.2	1.5
Heifers							
	655	-					
	820	23					
	835	11					
	880	10					
	885	20					
	970	85					
Bulls	964	105	18.1	2.0	4	26.6	2.1
	1027	33	20.7	.9	19	25.7	1.0
	994	15	20.8	.5	47	25.4	0.5
	1015	15	20.7	.3	46	27.0	0.4
	1095	22	21.5	.4	36	27.8	0.5
	1120	34	21.9	.5	14	29.4	0.8
	1209	47	24.5	.6	6	30.5	0.6
	1315	5	24.5	.7	2	30.6	2.3

[a]Deboned-defatted lean (muscle) tissue of the primal cuts expressed as a percent of live slaughter weight

[b]These numbers apply to the 66 steers and 174 bulls for which feed consumption and days on test were recorded.

[c]This assumes that composition of the gain on test (i.e. post weaning) was in the ratio observed on the carcass.

PRACTICES AND PRINCIPLES OF BEEF CATTLE BREED IMPORTATION AND EVALUATION WITH SPECIFIC REFERENCE TO CANADA'S PROGRAM[1]

A. S. Johnson[2]

Much has already been said at this meeting about the need to clarify objectives, to put things in perspective, and to get on with the job of breeding beef cattle so as to maximize efficiency of production of animal protein. Thus, systems which will apply known knowledge and quickly develop needed knowledge to accomplish this objective must have priority in our planning.

Numerous concepts in the past have reduced the rate of advancement of the beef cattle breeding industry to an even slower pace than that dictated by the long generation interval. Little is gained by enumerating these, other than to suggest that they have been reflected in a reluctance to interfere with the existing industry structure. It can also be stated that limited international movement of breeding stock in the past has significantly retarded acceptance of new approaches, inasmuch as it has tended to protect the established domestic breeds and, by so doing, permitted outmoded concepts to dominate in the industry beyond their period of usefulness. The opening up, in 1965, of quarantine facilities, to admit western European beef cattle breeds into Canada and into North America has been followed by an exciting surge of interest in new beef breeds and what they can contribute. To say that this development is entirely synonymous with greatly increased awareness of constructive breeding programs would be completely naive; the "fast buck" concept is what has generally prevailed. But it does seem evident that there is now a much more receptive audience to whom discussion and recommendations on long-term breeding plans can be addressed. Since breed utilization through the importation program has necessitated crossbreeding, and since the breeds and individuals selected have probably been in the upper range of performance merit, the result has helped to sell a concept, or at least establish good communication, more effectively and more quickly than ever before in beef cattle breeding. Thus, the potential of exploitation of available germplasm resources through a livestock importation facility provides a new dimension to livestock breeding which is very much needed if beef production is to remain competitive.

The first isolation unit for importation of livestock from western Europe (primarily France and Switzerland) was established by the Canada Department of Agriculture at Grosse Ile in the St. Lawrence River in 1964. The capacity was initially for 110 head of cattle. The unit was doubled in capacity the next year. In 1969, the quarantine facilities were expanded by the opening of another station, of equivalent size, on the island of St. Pierre off the coast of Newfoundland; this unit can be used twice per year. Thus, the total import capacity now is about 600 head per year. The stations provide for all possible precautions of disease control.

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[1]Presented at the Joint Meeting, Regional Beef Cattle Breeding Technical Committees, U. S. Meat Animal Research Center, Clay Center, Nebraska, August 10-12, 1970.

[2]Research Coordinator (Animal Breeding), Research Branch, Canada Department of Agriculture, Ottawa.

Whereas the importation program was identified initially with the Charolais breed only, there has been increased importation of other breeds, the Simmental, Limousin, Maine Anjou, and Brown Swiss being among them. The total number of animals imported, including those presently being purchased for entry, is over 2000.

While major attention of necessity has been given to ensure completely adequate disease control, this is only, in effect, the mechanics of providing access to new breeds, providing added genetic variability for breeding improvement. In recent years a technical advisory committee has reviewed breeding plans put forward by applicants requesting importation permits and has recommended priorities based on the proposals as presented. Emphasis has been given in the recommendations of the committee to establishing adequate numbers in breeds which seemed most clearly to provide a potential for improvement in the industry, and to encouraging buildup of limited numbers of herds to the point where they could begin to develop effective breeding programs. Accordingly, it has discouraged single animal importation as this does little for the concept of industry development on which the policy should be based.

If optimum use of an importation facility for the long-term benefit of the industry is accepted as being desirable it serves to underscore more than ever the need for effective planning and forward thinking in livestock improvement. Such planning should be based on careful evaluation of the biological potential of the species, as well as taking into account the nature and the structure of the industry involved. Accepting this as an objective, to gear this program to the needs of the 70's, some basic decisions have to be made, both of an administrative and technical nature. One of the most important decisions, and perhaps the most difficult, is essentially a political one. It is whether or not the government will assume the authority to decide how the facility should be used, having accepted that it was established for the purpose of livestock improvement and this is thus not different from other industry improvement programs. Since the facility is limited, two alternatives exist. One is to formulate a planned importation procedure, in the sense of recommending priority to certain breeds and then in fact limiting importation permits to these and to applicants who meet certain standards in terms of their breeding programs. The other approach is to throw the applications into a hat, draw out the required numbers, and declare the winners! Suffice it to say that I feel strongly that if importation policy is defined as it should, to improve our future livestock industry through this medium, then consistency would call for a broad plan, developed on the basis of breeding principles and geared to providing all technical knowledge available to maximize the longterm benefits from this exercise. If decisions are to be significantly influenced by political pressures, real or anticipated, then the utility of the program will fall considerably short of what it could be.

In keeping with the above concept, one would have to assume that the beef industry, as a national resource, and one which in the future will depend more and more on its competitive position, should be subject to some direction, or restraints, which might differ from its self-imposed restraints as a completely free enterprise where concern for the immediate rather than the more distant future is likely to dominate.

The burden would be placed on those who are required to develop and administer the importation policy to continuously examine it and revise it where necessary in this light. Its effective use would tend to further underline areas where more

research is required. Whatever importations of stock are made, it is obvious that improvement of breeds or lines will have to be continued by selection as well as through planned combination of breeds and, possibly, synthesis of new lines. Thus, the scope of the importation program should relate to the capacity of the industry to utilize the genetic material. The industry will need to be structured so it can handle these programs.

In planning for effective breed utilization (in this I include not only foreign but also domestic breeds), one of the most critical questions would seem to be a definition of the traits of importance at present and with future potential significance. In certain new breed combinations or as a result of use of different mating systems, certain traits may take on changed significance. Examples of these could include the factors that contribute to ease of calving, particularly in medium-sized female lines mated to specialized high growth sire lines. Here we have the possibility of an undesirable interaction between traits at extremes of the performance range. We may need to know much more about genetic differences in traits previously not considered as very important, such as size of pelvic opening, gestation length, and the influence, if any, of the fetus in initiating parturition. The pressure will be on to identify some of these traits through research. The number of these important traits and their relative economic significance will likely affect the numbers of breeds considered necessary for importation. Our planning for the future beef industry will need to take account of the production systems which will likely be involved. Range production of beef cattle will no doubt be with us for a long time, but there is also little doubt that, as we have known it, it will form an increasingly smaller percentage of the total beef production. Thus, different genotypes may be called for by these different systems. Couple with this the possibility that the calf may be raised more economically on other than milk from the cow, and that this cow will need to be one which, in a high frequency of cases, can produce at least two calves rather than one, and we see some of the situations for which we need to be prepared. Since we do not know clearly yet how these trends will develop, a partial answer lies in retaining "genetic flexibility", that is the capacity to search for and utilize breeds to fill specific needs--but, again, we should define the needs!

While we may not be able to identify all the traits of future importance in beef cattle breeding, it is obviously highly urgent to try to obtain and assess comparative performance data on traits recognized as important in the breeds proposed for importation. Available scientific literature on these breeds should be examined for what it can contribute. We should not, in our enthusiasm over foreign imports, overlook what our own domestic breeds have to offer. What is the evidence, for example, that for the production of specialized female lines, either for specific single crosses or for a rotational system, we can improve on the breeds already available on this continent? We can really only answer this question when we know what we should be looking for in these lines. This puts the problem right back into the research area; and an important part of this research may be economic as well as biological.

In an importation program, at best costly, and necessitating making choices between breeds, the possibility of setting up specifically-designed testing programs (in the countries of origin) to evaluate prospective breeds should at least not be overlooked. It is recognized that this could be complicated if involving more than one country. On an even broader basis, the value of such a program in its implications for international development could at least be considered.

Assuming a departure from free enterprise (i.e., preference based on some decision-making will be given to certain breeds), the question immediately arises as to what breeds should be imported and how priorities should be established. This will need to be based on a comprehensive assessment using the criteria and the procedures already discussed. It should be mentioned that in selection within breeds for importation, to date, not all available records have been fully utilized.

If the recognized objective is to maximize the contribution of imported breeds, the following procedures are proposed.

(a) Use of the facility should be devoted to a minimum number of breeds at any one time and to building these up as rapidly as possible within the industry; this is as opposed to a "free choice" system. I suggest that the exploitation concept in regard to the imported breeds, which is dominant in the current philosophy of the industry, is not in itself conducive to the best animal breeding practices, although healthy economic advantage of their use is obviously important. The present importers cannot afford to practice culling. It would be desirable to remove some of the glamour and "gobbledy gook" which surrounds this procedure and get down to the pedantic business of manipulating genes for the purpose of maximizing production of lean beef. Thus space in the importation facility should be allotted to a sufficiently limited number of recommended breeds to provide an adequate sample of the genes of each for evaluation. When that point has been reached, preference should be given to other breeds. Thus, use of the facility should be restricted to those breeds which are considered to have the most promise, based on a continuing assessment of industry developments and needs utilizing all the evidence available.

(b) In conjunction with the decision to limit the number of breeds at any one time, it is suggested that, for distribution to the industry, bulls only should be imported; these would obviously be most effectively utilized through artificial insemination. This would mean that the industry would be committed to a system of backcrossing for building up herds with the desired percentage of the introduced genes. Because import facilities are restricted, importation of purebred females would not permit buildup of herd numbers to adequate levels any more rapidly than a backcrossing program; I suggest that female importation has other disadvantages in terms of the exploitation and the political pressures which it generates by the very fact that certain producers acquire prior advantage over others to produce purebred stock while it is still selling at unreal prices. Furthermore, it is not evident that bringing in pure females, as opposed to backcrossing, has any advantage whatsoever in achieving the goal of developing viable herds of a size necessary for effective selection. Herd buildup through backcrossing is presently a major factor in the establishment of new breeds. It could just as well be the only means. What is a reasonable number of bulls to sample a breed? Some arbitrary decisions may be needed, depending on various circumstances relating to the importation. I would suggest a minimum number of 30 bulls and a maximum number of 50.

(c) If importation of females is considered this should be only as a single research herd. This could pose a problem of disposing of surplus females. This herd might be used to measure important differences in performance, under commercial conditions, or to assess physiological differences. The importance of this purebred evaluation is proposed as secondary to testing the performance of F_1 progeny of the breed; it should be considered only for the more promising breeds.

(d) An importation policy should include a plan to rapidly evaluate the imported breeds for their crossing ability with other breeds. It is highly desirable to try to build this into the total importation plan to provide objective comparisons as early as possible. One could question admitting breeds into the country without a reasonably critical means of evaluating evidence of their worth and their potential for commercial beef production. There should be concern for more than giving a few of the early buyers a chance for some quick financial gains. Testing and comparison of these breeds can be done by research establishments themselves; this is the ideal way for those organizations which are of sufficient size. It can also be done in industry, under direction of research scientists and supervised by trained field staff, by means of adequately designed tests conducted in private contract herds. Unless this research is done, it will be very difficult to obtain valid comparative information on some of the more important traits in projecting the future role of these breeds.

(e) Another useful approach will be if breed associations undertake programs of breed assessment and improvement. These will likely be within-breed improvement programs, such as the Conception to Consumer program of the Canadian Charolais Association, which has now been expanded to include the Simmental breed. The important principle is that these are producer groups engaged in breed improvement programs of their own.

(f) The breed importation program should be identified and recognized as part of an overall livestock improvement plan for the country. The technical aspects of the plan should be developed by a committee or board consisting primarily of animal geneticists and other personnel concerned directly with livestock improvement programs. Animal health decisions should make for a safe importation program but beyond that they should not compromise the decisions of the committee. This committee should have the function of making final decisions on foreign breed importation and allocation and should be familiar with or preferably involved in any other improvement programs which exist. Ideally, allocations of breeding stock to different areas of the country should be related to livestock improvement programs underway in those areas and the potential for such stock. This board or committee would concern itself also with the means whereby evaluation data on the imported breeds could be obtained.

In all the fervor of breed importation that exists at the present iime, we should have answers to a number of questions. How many breeds should be imported

and with what urgency? The answer is not entirely clear. The question relates, in part, to how many breeds or lines cnn be effectively handled in any breeding system developed in the industry at any time. If we have identified growth rate as the main desirable trait in certain foreign breeds, these, then, are prospective sire or terminal lines. How many, then, do we need? Are four better than two, and six better than four? Should we be considering any more than these and, if so, why? I suggest that we should be thinking out the answers,which involves, mainly, determining how these breeds should be used. The importation program should relate to the means for maintaining and improving these breeds. In addition, should you select certain breeds, perhaps of moderate growth rate, as prospective components of female lines? How do you identify these? What traits do you look for and within what range of expression? What will your mating system be whereby you utilize these breeds?

There are some answers, or good hunches, relating to these questions. It is unlikely that we have the final answer for any, but it behooves us to proceed with the importation, testing and utilization of foreign breeds as their worth is indicated and in keeping with our capacity to handle them. There are good indications, that many of these breeds will be used constructively for what they have to offer. It is important, however, to supplement, as quickly as possible, the present evidence of their merit with additional information on their effective utilization.

The fact that the quarantine procedure is the only way in which foreign breeds from certain countries can be obtained can be used as a legitimate means of providing direction to an industry, if we subscribe at all to the principle that an industry should be guided, in order to help to assure its future. I propose that this is a valid function and does not need to be considered an infringement of an individual's rights. If this is not acceptable, then the system of "random choice" already mentioned is the only alternative.

If the principle of directing the program is accepted, the test will be how the facility is administered and the plan that is developed from it. Choice of initial breeds will be relatively easy; later decisions between breeds will be more difficult. There is merit in a policy of a controlled testing program for additional breeds which can do a better job, but the complexity of such a program has been mentioned. Some of these breeds will, and should, be discarded or at least identified as to their degree of economic merit, hopefully more clearly than often is the case now. But I think it is clear that the breed evaluation is only part, and perhaps, in its initial stages, the simplest part, of a total breeding system which will be necessary to keep beef production as a viable procedure of protein production in the 70's.

Now I wish to describe briefly the foreign breed evaluation program of the Canada Department of Agriculture Research Branch. Samples of two breeds were purchased by the Branch at the time of their first importation into Canada through Grosse Ile. A group of Simmentals, or Pie Rouge, were brought to the Lacombe Research Station in 1967 and a similar sample of Limousin came to the Brandon Research Station in 1968. The numbers were supplemented with additional females in each breed purchased in 1969. A program of evaluation, similar at both Stations, is designed to provide some limited information on the imported pure breeds but major emphasis is put on evaluating the F_1 progeny from crosses with the three British breeds, Hereford, Angus, and Shorthorn. In these evaluations the Charolais breed is crossed along with the Simmental and Limousin with the same breeds to provide a basis for comparison. The F_1 progeny are produced by contracting with

private herds in which matings are made, all by artificial insemination, utilizing semen from each of the three breeds and, thus, producing nine different breed crosses. In the current year semen from 10 to 12 bulls per breed will be used.

Data are being obtained on birth weights, gestation length, ease of calving, preweaning, feedlot and carcass traits of males, and on reproductive performance of the cross-bred females. Calves are bought at weaning from the cooperators for the postweaning test at the Research Stations. The evaluation project for one breed will be carried over several years. As part of this program, it is planned to evaluate samples of the female crossbred groups under range conditions in the Lethbridge Research Station program. The numbers projected for evaluation of each specific breed cross are about 100 of each sex. The plan is to use three breeds of terminal sires on each group of crossbred females.

At present the C.D.A. Research Branch has not made specific plans for evaluating additional foreign breeds. The need for the information is recognized. Decisions on priority of programs, and on breeds for testing will continuously come up, as the facilities required are fairly extensive. There is also, somewhat ironically, some problem in obtaining contract herds in view of competition from breeders who are interested in their use to build up the imported breeds as quickly as possible. Another demand for these herds is in the testing programs such as of the Charolais Association.

Information from the breed evaluation program is released on a preliminary basis to the industry as it is gathered to provide for an early indication of the important traits associated with these breeds, such as birth weight of calf in relation to ease of calving. Suffice to say that there is a great deal of interest in this information, and, in addition to its direct use, it helps provide for a better channel of communication with industry. An evaluation program such as this, while obviously quite applied, will provide the industry with comparative information of a nature which it could not otherwise obtain, thus helping to dispel a lot of possible conjecture and misunderstanding. The justification of this work being done by research stations may continue to be debated by some. The answer must be arrived at in deciding what are the most pertinent problems of the industry they serve and the means available for dealing with them.

In brief summary, I have identified some ways in which I think a breed importation program can be used to maximize the real benefits to the industry in producing beef more cheaply. Some of the emotion and glamour being built around the new breeds does not fit with this concept; these should be replaced by objective results and proposals for breed utilization. What we must be concerned about is keeping the beef industry in business, and in this we must consider the future industry as well as that presently in existence. The future is bright if developed on the basis of goals which emphasize productive efficiency. The new breeds provide a stimulus and one approach in reaching these goals.

TEXAS-ARGENTINA COOPERATIVE EVALUATION PROGRAM

T. C. Cartwright

The Texas Agricultural Experiment Station (TAES) has a cooperative project with Instituto Nacional Tecnologia Agropecuaria (INTA), the federal agricultural research agency for Argentina, entitled "Beef Production Potential of Exotic Breeds and Their Crosses Under Extensive Pasture Conditions" and numbered TAES S-1760. This cooperative project is sponsored only by INTA and TAES. INTA has the responsibility for collecting data and TAES has the responsibility for data processing and analysis. Procedures and design are controlled by INTA and TAES makes consultation available.

The project is designed to test the suitability of various breeds for beef production in Argentina. Environmental and management condition are probably more similar to those in the U. S. than any other one country, other than Canada. Emphasis is being placed on use of semen from Continental European and Argentine dairy breeds. Growth and carcass data have been collected, punched and transmitted to Texas for analysis for the breeds and crosses listed below (x):

Fleckvieh (F) x Angus (A)
Gelvieh x Angus
Limousin (L) x Angus
Santa Gertrudis x Angus
Brahman x Angus
Holando Argentino x Angus
Charolais x Charolais (C)
Hereford x Hereford
Angus x Angus
Angus x A-C
Charolais x A-C
A-C x A-C
Fleckvieh x A-F
Limousin x A-L

Calves sired by Italian breeds; Chianina, Piedmont, Romagnola; have been weaned. Their weights, appearance and uniqueness have created considerable interest. Other breeds will be incorporated in the project as time and facilities permit.

STATE REPORTS

AUBURN UNIVERSITY
Agricultural Experiment Station

I. PROJECT: Hatch 219 (S-10)

The effect of environment, genetic-environmental interaction and heterosis on performance of beef cattle.

II. OBJECTIVES:

To evaluate the effect of environment and genetic progress under phenotypic selection.

To determine the effectiveness of selection for total performance in beef cattle.

To determine the influence of heterosis on rate of gain, carcass quality and cow performance.

II. PERSONNEL:

T. B. Patterson and G. B. Meadows

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Scope and nature of work.

The combination of land area, rainfall and long growing season which results in the production of abundant forage, makes the Southeastern United States well adapted to beef production. In order to maximize these natural advantages, there is a definite need for the improvement of the mean performance of beef cattle.

The differential response in various species of animals to their climatic environment has been adequately substantiated. Most of our present breeds of livestock were developed for adaptability to certain environmental conditions as well as to perform specific functions.

Presently beef cattle are being performance tested under specific conditions, while their progeny are expected to perform under a wide range of conditions. In theory, the measurable variance of different traits is composed of variance due to genotype, environment and their interaction. Only change in the additive fraction of the genetic variance results in permanent progress in response to selection. Nevertheless, the magnitude of the environmental and/or genetic-environmental fraction can definitely influence the effectiveness of a selection program. Further, by providing the optimum environment and by taking advantage of genetic-environmental interactions, higher production levels are possible.

There is need for additional research to determine the effectiveness of selection for total performance beef cattle. In essence, information is needed to test whether the apparently large additive genetic variance, as determined by heritability estimates, can actually be exploited in a program of mass selection.

Heterosis is the increased vigor often exhibited by progeny from the mating of two distinct families, breeds or species. Livestock do not possess, to an equal degree, the adaptability of plants to a breeding program that permits maximum utilization of hybrid vigor. Nevertheless, the superior performance of breed crosses of swine indicates the need for additional research to determine the value of such a breeding method with beef cattle. This is particularly true with reference to the effect of heterosis on mothering ability and on progeny from a continuous crossbreeding program.

Purebred herds of the Angus and Hereford breeds located at the Beef Cattle Research Unit, Auburn University, provided the foundation stocks for this study. Each breed was divided into high and low performance groups based initially on previous record, where available, and on a performance index where previous record was not available. These groups were subdivided into two equal groups, again based on previous record or index. Thus, there are two high and two low performance groups for each breed. This makes a total of eight herds. One high and one low performance herd of each breed was assigned to each of two nutritional regimes.

Winter feeding levels are the same for all eight herds. However, the high nutritional groups are placed on the best legume pastures in the spring while the low nutritional groups remain on silage until grass pastures are available. In addition, the calves in the high nutritional groups are given access to a creep feed which is high in protein and low in carbohydrates. No other environmental differences are imposed on the two nutritional groups.

After weaning, all cows are subjected to similar management conditions. All calves are handled alike on postweaning test. Replacements are selected by index within groups.

Data collection include birth weight, weaning weight (250 day) weaning score, finish score, ultrasonic fat thickness, postweaning gain (140 days for bulls and 120 days for heifers), final score, final finish score, final ultrasonic fat thickness and weight of bulls at 400 ± 15 days.

Cows produced in a previous crossbreeding study have been used to study the effect of heterosis on mothering ability in beef cows. These cows include purebred Angus, Hereford and Shorthorn cows bred to produce two-breed cross calves and two-breed cross bred cows from among the same breeds bred to the third breed to produce three-breed

cross calves. Thus, comparisons are made between two-breed cross calves nursing purebred cows and three-breed cross calves nursing crossbred cows. Pre- and postweaned performance data were obtained on all calves. In addition, all steer calves were slaughtered and complete carcass information obtained.

2. Research results.

Data for the third full year have been completed through postweaning performance. These data do not reveal anything different from the previous two years, and, therefore, will not be presented in tabular form. Both bulls and heifers from the high nutritional groups weaned heavier. However, as in the past the low nutritional groups gained faster postweaning. Differences were not as great between heifer groups as between bull groups. Weight per day of age at 400 days favored the high nutritional group. Less differences were noted between breeds than had been shown in either of the two previous years.

Of special interest is the effect of preweaning nutritional levels on reproductive performance as two and three year olds. Numbers are small since there have been only two groups of heifers that have calved as two year olds and one group that has calved as two and three year olds. These data are summarized in table 1 and are expressed as ratios with percentages in parentheses. Heifers raised under the low-nutritional regime are smaller at a given age which apparently affects their reproductive performance and ease of calving as well. In addition, two of the low nutrition heifers (one Angus and one Hereford) died while calving. The crossbreeding phase was completed during the last year. These data are being analyzed and will be published as part of a bulletin on crossbreeding.

Data for the second full year have been completed through postweaning performance. These data are summarized in table 1. Differences in adjusted weaning weight for both breed and level of nutrition were less than those for the 1966-67 calves. (See 1967 annual report.) With respect to nutritional levels, the small differences in weaning weight along with some compensatory gain resulted in little difference in W/DA at the end of test. Since numbers are small and these data cover one calf crop, no further inferences will be made.

As indicated in the project outline, cow numbers were to be increased to 120 brood cows per breed. This number would represent four herds of 30 cows each per breed. This objective has been obtained. In addition, herd bulls have been retained on a within herd basis so that foundation bulls will not be used in the 1971 breeding season.

Calves produced on the high nutritional level gained faster from birth to weaning. Calves produced on the low nutritional level gained faster postweaning. However, weight per day of age still favored the high level calves at the end of test. Female replacements from the high nutritional level produced more calves as two year olds and had fewer death losses at calving. Numbers are small but the same appears to be true as three year olds. The crossbreeding study has been completed and is being prepared for publication.

Table 1. The Effect of Nutritional Level on Reproductive Performance as Two and Three Year Olds

Breed	Angus				Hereford			
Nutritional level	High		Low		High		Low	
Calving as 2-yr. olds	23/24	(96%)	25/30	(83%)	19/20	(95%)	16/24	(67%)
Calves born dead	2/23	(9%)	4/25	(16%)	2/19	(10%)	3/16	(19%)
Calving as 3-yr. olds	6/6	(100%)	6/8	(75%)	9/9	(100%)	11/13	(85%)

V. FUTURE PLANS:

The project will be continued on the present basis.

VI. PUBLICATIONS DURING THE YEAR:

Summary Beef Cattle Performance Test

VII. PUBLICATIONS PLANNED:

None

I. PROJECT: Animal Science 4-016

A comparison of crossbreeding and within breed selection on beef cattle production in the Black Belt Area of Alabama.

II. OBJECTIVES:

To evaluate the significance of hybrid vigor in various crosses of beef cattle with regard to production of slaughter calves, stocker or feeder steers and slaughter steers.

To determine the effect of heterosis on mothering ability adaptability and fertility.

III. PERSONNEL:

Troy B. Patterson, L. A. Smith and Harold Grimes

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Scope and nature of work.

Few crossbreeding studies have furnished adequate results with reference to: (1) Mothering ability of breeds and their crosses, (2) The relative merits of various breed crosses for slaughter calves, stocker calves and slaughter steers, (3) The performance of second, third and subsequent generation crosses of British x Brahman and crosses among the British breeds, (4) The application of these results to a practical breeding program. Recent increases in production costs and lower prices received for cattle have resulted in many beef producers making little, if any, net profit. Obviously, these producers must either cut expenses and become more efficient or increase production per brood cow with little interest in cost of operation.

The breeding and forage programs at the Black Belt Substation have been adequate to consistently produce calves that wean at over 500 pounds, The steer calves have reached the acceptable market weight of 1000 pounds at approximately 15 months of age. However, comparisons between established crossbreds and those with Charolais breeding would indicate potential for improvement. In addition, the better performing crossbreds have not produced more desirable carcasses from the standpoint of ratio of fat to lean and cutability (as determined by yield grade). Improvement in this respect due to breed composition appears possible.

Mature Hereford and 1/2 Angus- 1/2 Hereford crossbred cows were divided into similar groups based on breed. One group was bred to a Hereford bull and the other group to a Charolais bull. Cows are rotated each year to minimize cow differences between groups. Four groups of calves are produced each year, namely (1) Hereford, (2) 3/4 Hereford, 1/4 Angus, (3) 1/2 Charolais, 1/2 Hereford and (4) 1/2 Charolais, 1/4 Hereford, 1/4 Angus. These calves are born, for the most part, in late fall and early winter.

One Hereford bull and one Charolais bull were used for two consecutive years. Groups of cows were reversed by breed of bulls for the second year. At the end of the second season, all cows were reallotted and two new bulls obtained.

All calves are creeped until pasture is available in the spring. Additional creep is used only when pastures' conditions are such that supplemental feeding becomes necessary to maintain normal growth. Environmental differences between groups are minimized by pasture rotation on a regular basis.

Weaning weights, slaughter and feeder grades are recorded. An estimated market value is obtained at weaning by an experienced local cattle buyer.

At weaning, the steer calves go directly to the feedlot where they are fed by breed groups to an average shrunk weight of approximately 1000 pounds. The steers are marketed by breeding groups as they reach the desired weight. Data collected includes feedlot gain, feed efficiency, complete slaughter data and a tenderness evaluation based on samples from a two-inch rib section from the left side taken at the 12th rib of each carcass.

2. Research results.

Two calf crops have been weaned and the steers fed out and slaughtered. A two-year summary of the weaned data are included in table 1. Substantial increases in weaned weights resulted from using Charolais bulls on two breeding groups of cows when compared to Hereford bulls bred to the same types of cows. Charolais bulls sired calves that were 82 pounds heavier out of Hereford cows and 70 pounds heavier out of 1/2 Hereford, 1/2 Angus cows. Charolais sired calves were valued at $16.94 more per head than were Hereford sired calves.

A two year summary of feedlot performance is included in table 2. All steers performed well. However, the Charolais sired calves gained faster, 2.82 pounds per day, compared to 2.43 pounds per day for Hereford sired calves. Feed conversion was excellent based on performance. The Hereford sired calves required 897 pounds of feed per 100 pounds gain while the Charolais sired calves required 932 pounds of feed per 100 pounds gain. This small difference should be expected in that the Charolais cross calves averaged 101 pounds heavier during the feeding period than did the Hereford sired calves. Thus, more feed is required for maintenance. The Hereford sired steers appeared to be fatter at the end of the feedlot period and graded slightly higher on foot.

Carcass data were obtained and the two years are summarized in table 3. Charolais sired steers produced heavier carcasses. Also of interest is the higher dressing percent for the Charolais sired steers compared to the Hereford sired steers, especially since the latter group had twice the amount of outside fat/cwt. carcass. In addition, this outside fat was not reflected in higher carcass grades as might be expected. Rib-eye area and yield grade favored the Charolais sired steers.

Charolais sired calves, when compared to Hereford sired calves, grew faster and yielded more desirable carcasses for every trait studied.

Table 1. Two Year Summary Weaning Data 1967-69
Black Belt Substation, Marion Junction

	Breeding of calves			
	Hereford	3/4 Here. 1/4 Angus	1/2 Char. 1/2 Here.	1/2 Char. 1/4 Angus 1/4 Here.
No. of calves	27	32	20	21
Av. birth wt., lbs.	70	66	85	79
Av. adj. weaned wt., lb.[1]	552	585	634	655
Av. feeder grade[2]	13.6	13.8	13.8	14.2
Av. market value, dollars	152.68	167.31	174.16	180.78

1 250 days weaning, mature dam-steer equivalent.
2 13 = choice; 14 = high choice.

Table 2. Two Year Summary Feedlot Data 1967-69
Black Belt Substation, Marion Junction

	Breeding of steers			
	Hereford	3/4 Here. 1/4 Angus	1/2 Char. 1/2 Here.	1/2 Char. 1/4 Here. 1/4 Angus
No. of steers	11	11	12	12
Av. days on feed	154	161	166	154
Av. initial wt., lbs.	614	594	665	705
Av. final wt., lbs.	998	1028	1148	1126
Av. daily gain, lbs.	2.49	2.56	2.91	2.73
Av. W/DA at slaughter, lbs.	2.42	2.44	2.70	2.70
Av. feeder/cwt. gain[1]	904	890	863	1000
Av. final grade, live[2]	13.1	13.7	12.6	12.3

1 35% roughage, 65% concentrate.
2 12 = low choice; 13 = choice.

Table 3. Two Year Summary Carcass Data 1967-69
Black Belt Substation, Marion Junction

	Breeding of steers			
	Hereford	3/4 Here. 1/4 Angus	1/2 Char. 1/2 Here.	1/2 Char. 1/4 Here. 1/4 Angus
Av. hot carcass wt., lbs.	585	602	688	684
Av. dressing % (hot carc.)	58.6	59.5	61.2	61.9
Av. carcass grade, Fed.[1]	11.8	12.8	12.5	12.8
Av. carcass W/DA, lbs.	1.41	1.43	1.62	1.64
Av. adj. ribeye/cwt. carcass, sq. in.	2.04	2.20	2.48	2.48
Av. backfat/cwt. carcass, in.	0.10	0.11	0.05	0.06
Av. yield grade[2]	3.3	3.5	2.5	2.6

[1] 11 = high good; 12 = low choice; 13 = choice.
[2] Low values more desirable.

V. FUTURE PLANS:

Continue as outlined.

VI. PUBLICATIONS DURING THE YEAR:

None.

VII. PUBLICATIONS PLANNED:

Crossbreeding beef cattle in the Black Belt Area of Alabama.

I. PROJECT: Animal Science 4-017

The effects of breed and breed crosses on milk production and on other production factors in a grade beef herd.

II. OBJECTIVES:

To determine the effect of Brown Swiss, Holstein and Charolais breeding on (a) milk production, (b) weaning weights and grades, (c) feedlot performance, and (d) carcass desirability.

III. PERSONNEL:

T. B. Patterson and R. A. Moore

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Scope and nature of work.

Many of the commercial beef herds in the Southeast were established with common cows of predominately dairy breeding as foundation females. Purebred beef bulls were used in a grading-up process. Most of the build-up in numbers and subsequent grading-up process occurred within the past 15-20 years when market price and demand favored a so called "milk fat calf". Consumer preference has changed over the past five to ten years to a demand for heavier beef. Nevertheless, most commercial producers in Alabama still market their calves at weaning, and total weight and price per cwt. determine gross receipts.

In the opinion of many commercial breeders there is an apparent deduction of milking abilities of brood cows associated with the grading-up process. Milk is the most important source of quality nutrients in the diet of the beef calf. Producers are faced with the choice of reverting to the original type cows that are often lacking in beef conformation and/or inherent ability to gain, or attempting to improve milk production within the existing herd through phenotypic selection. Obviously, improvement in milk production can be accomplished most rapidly through the use of selected sires since a sire constitutes roughly one-half of the genetic make-up of the herd.

Seventy-five grade beef cows were divided into similar groups of 25 each on the basis of age, breeding, and previous production record each year. They were bred to Hereford (control), Brown Swiss and Charolais bulls. The bulls were changed each year. A group of Holstein and Holstein-Jersey cows were bred to the Hereford bulls.

Additional information such as milk production of the original cows at 90 and 250 days of lactation was established. Performance information on all calves to weaning can be related to milk production of their dams. Post-weaning performance and carcass data on all steer calves provided information on the effects of breeding on production.

All physically sound heifers produced by the procedure described above have been retained until approximately 25 breeding age females per breeding group were available. These heifers were bred to closely related Hereford bulls selected from a high producing herd. Only bulls with above average weaned weights were considered. Milk production obtained from this set of females will provide a comparison with the original and with subsequent herd milk production levels. Milk production and breed of dam is confounded, however, differences in calf weaned weights reflect these two important brood cow characteristics.

All steer calves are full fed on corn silage plus supplement until they have reached 1000 pounds and average in the choice grade. Carcass data are obtained on all steers. As before, all physically sound heifers are retained as replacements for the next generation.

2. Research results.

The steer calves produced in the 1967-68 calving season were fed out and slaughtered. The weaning information was reported in the 1969 annual report. A summary of the feedlot performance is presented in table 1. The quality of the corn silage was poor which accounted for the poor performance in all breeding groups, during the growth period. Performance during the finishing period was good. Numbers are small, however, the backcross steers were heavier at slaughter than the Hereford controls.

There were no significant differences between breeding groups for any carcass traits (table 2) measured with the exception of carcass weight and rib-eye area per cwt. carcass. The average differences in carcass weight over the Hereford control are: 16, 47 and 83 pounds, respectively, for the 1/4 Brown Swiss, 3/4 Hereford, 1/4 Charolais, and 3/4 Hereford and 1/4 Holstein, 3/4 Hereford. The 1/4 Charolais 3/4 Hereford steers had a larger average rib-eye area per cwt. carcass and had less fat with better yield grades than did the other groups of steers.

A two year summary of weaned data are shown in table 3. The backcross calves were significantly heavier at weaning than were the Hereford calves. The differences were 90, 68 and 87 pounds heavier for the Brown Swiss, Charolais and Holstein backcrosses, respectively. The backcross calves were also heavier at birth.

Milk production and fat percentages are shown in table 4 for the foundation cows and for the first generation cows. Average weaned weight of calf and milk production of dam are in the same rank order.

Hereford backcross calves out of crossbred cows were heavier at birth, weaning and slaughter than were calves out of Hereford cows. In addition, the backcross calves had heavier carcasses that were equal from the standpoint of quality as well as yield grade. The crossbred cows produced more milk than the Hereford cows. However, the Hereford milk was slightly higher in butterfat.

Table 1. Feedlot Performance - 1967-68 Steers

	Breeding of steers			
	Here.	3/4 Here. 1/4 B.S.	3/4 Here. 1/4 Char.	3/4 Here. 1/4 Hol.
No. of steers	9	5	7	6
Initial wt., lb.	561	598	638	646
ADG on silage, lb. (190 days)	1.29	1.23	1.16	1.40
ADG finishing period, lb. (68 days)	2.34	2.42	2.47	2.60
ADG postweaning, lb. (258 days)	1.56	1.55	1.50	1.72
Final weight, lb. (shrunk)	965	998	1026	1090
Final live grade	12.5	10.5	11.1	12.5

Table 2. Carcass Data 1967-68 Steers

	Breeding of steers			
	Here.	3/4 Here. 1/4 B.S.	3/4 Here. 1/4 Char.	3/4 Here. 1/4 Hol.
No. of steers	9	5	7	6
Final wt., lb. (shrunk)	965	998	1026	1090
Hot carcass wt., lb.	589	605	636	672
carcass grade, Fed.	11.7	12.0	11.6	12.0
Fat thickness, in.	0.39	0.32	0.27	0.32
Rib-eye area, sq.in.(per cwt. carcass)	1.82	1.72	1.88	1.65
Yield grade	2.9	2.8	2.3	2.9

Table 3. Two Year Summary 1967-69

	Breeding of calves			
	Here.	3/4 Here. 1/4 B.S.	3/4 Here. 1/4 Char.	3/4 Here. 1/4 Hol.
No. of calves	32	28	34	34
Avg. birth weight, lb.	63	66	69	70
Avg. adjusted weaned wt., lb.	469	559	537	556
Avg. feeder grade	12.6	12.0	12.8	12.4

Table 4. Milk Production and Butter Fat Percent

Breeding group	No. of cows	Milk yield lb.	Butter fat %
Foundation (Grade Hereford)	64	4.66	3.47
First generation	72	7.44	4.32
Hereford	14	5.75	4.83
1/2 Brown Swiss-1/2 Hereford	21	7.43	4.40
1/2 Charolais-1/2 Hereford	21	6.91	3.95
1/2 Holstein-1/2 Hereford	16	9.62	4.25

V. FUTURE PLANS:

The project will be continued as outlined.

VI. PUBLICATIONS DURING THE YEAR:

None,

VII. PUBLICATIONS PLANNED:

A popular type report on the first phase of this study.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Alabama

Location		Auburn	Auburn	Auburn	Auburn	
Breed of sire		Hereford	Hereford	Hereford	Hereford	
Breed of dam		Hereford	Hereford	Hereford	Hereford	
Line or group[1]		EI GI	EI GII	EII GI	EII GII	
Percent used in project		100	100	100	100	
Inventory as of July 1,	Cows 2 years and over	27	23	31	25	
	Yearling heifers	6	8	7	7	
	Bulls and steers under 1 year	9	16	12	19	
	Heifers under 1 year	15	8	8	14	
	Bulls over 1 year	2	1	2	1	
	Steers over 1 year	0	0	0	0	
Repro. perf.	Percent pregnant[2]	89.3	85.7	64.7	85.2	
	Calf survival percent[3]	96.0	100.0	95.4	95.6	
Wean perf.	Adj. ADG[4]	2.03	2.04	1.76	1.74	
	~~Av. type sc.~~[5]	13.0	12.8	12.8	12.6	
Postweaning performance	No. of bulls	9	4	8	5	
	No. of heifers	6	10	8	11	
	No. of steers	1	2	3	0	
Slaughtered	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	1	2	3	0	
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: (To steer and mature dam)

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Alabama

Location		Auburn	Auburn	Auburn	Auburn	
Breed of sire		Angus	Angus	Angus	Angus	
Breed of dam		Angus	Angus	Angus	Angus	
Line or group[1]		EI GI	EI GII	EII GI	E II GII	
Percent used in project		100	100	100	100	
Inventory as of July 1, 1970	Cows 2 years and over	29	28	30	31	
	Yearling heifers	9	8	8	8	
	Bulls and steers under 1 year	13	14	13	10	
	Heifers under 1 year	11	13	12	16	
	Bulls over 1 year	2	1	2	1	
	Steers over 1 year	0	0	0	0	
Repro. perf.	Percent pregnant[2]	93.8	87.5	77.8	90.3	
	Calf survival percent[3]	80.0	96.4	92.8	92.8	
Wean perf.	Adj. ADG[4]	2.18	1.96	1.88	1.83	
	Av. type sc.[5]	13.4	13.1	13.0	12.9	
Postweaning performance	No. of bulls	6	4	8	4	
	No. of heifers	10	12	12	9	
	No. of steers	3	2	1	3	
Slaughtered	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	3	2	1	3	
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: **(To steer and mature dam),**

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Alabama

Location		Marion Jct.	Marion Jct.	Marion Jct.	Marion Jct.	
Breed of sire		Hereford	Hereford	Charolais	Charolais	
Breed of dam		Hereford	½ Angus ½ Hereford	Hereford	½ Angus ½ Hereford	
Line or group[1]		Grade	Crossbreds	Crossbreds	Crossbreds	
Percent used in project		100	100	100	100	
Inventory as of July 1, 1970	Cows 2 years and over	12	11	11	19	
	Yearling heifers	4	11	3	3	
	Bulls and steers under 1 year	6	10	5	3	
	Heifers under 1 year	5	7	2	4	
	Bulls over 1 year	1		1		
	Steers over 1 year	0	0	0	0	
Repro. perf.	Percent pregnant[2]	84.6	94.7	63.6	81.8	
	Calf survival percent[3]	100.0	94.4	100.0	78.8	
Wean perf.	Adj. ADG[4]	1.97	2.10	2.25	2.36	
	Av. type sc.[5]	13.6	13.8	14.1	14.3	
Postweaning performance	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	6	7	6	6	
Slaughtered	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	6	7	6	6	
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: (To steer and mature dam).

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Alabama

		UCPSS Winfield	UCPSS Winfield	UCPSS Winfield	UCPSS Winfield	
Location		UCPSS Winfield	UCPSS Winfield	UCPSS Winfield	UCPSS Winfield	
Breed of sire		Hereford	Hereford	Hereford	Hereford	
Breed of dam		Hereford	1/2 Heref. 1/2 Charol.	1/2 Heref. 1/2 B Swiss	1/2 Heref. 1/2 Holst.	
Line or group[1]		Grade	Crossbred	Crossbred	Crossbred	
Percent used in project		100	100	100	100	
Inventory as of July 1,	Cows 2 years and over	18	28	27	25	
	Yearling heifers	10	13	12	16	
	Bulls and steers under 1 year	7	10	11	12	
	Heifers under 1 year	7	10	10	4	
	Bulls over 1 year	6	0	0	0	
	Steers over 1 year	0	0	0	0	
Repro. perf.	Percent pregnant[2]	84.2	78.6	81.5	68	
	Calf survival percent[3]	87.5	90.9	95.4	94	
Wean perf.	Adj. ADG[4]	1.63	1.88	2.00	1.90	
	Av. type sc.[5]	12.7	12.6	11.9	12.5	
Postweaning performance	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	10	13	11	11	
Slaughtered	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	10	13	11	11	
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: (To steer and mature dam).

5 - Suggest S-10 scoring system; indicate if different.

UNIVERSITY OF ARKANSAS
Agricultural Experiment Station
Fayetteville, Arkansas

I. PROJECT: Hatch 170

Evaluation of performance records of beef cattle.

II. OBJECTIVES:

Continue to develop practical but adequate methods for identifying, evaluating and propagating the genetic potential for the production of beef.

II. PERSONNEL:

C. J. Brown, R. S. Honea, and Lans O. Brown

IV. ACCOMPLISHMENTS DURING THE YEAR:

Purebred and crossbred matings as indicated by the inventory were made. Data on postweaning performance and carcass data of bulls and steers were recorded. Analyses of weight-age curves and individual feeding data have been in progress.

V. FUTURE PLANS:

Continue analyses in progress and collection of data according to project outline.

VI. PUBLICATIONS:

Brown, C. J. and R. S. Honea. 1969. Genetic aspects of growth rate of beef bulls. Ark. Expt. Sta. Bul. 745.

Brown, C. J., M. L. Ray, F. Smith, R. M. Smith, Jr. 1970. Factors affecting weaning traits of beef calves in eastern Arkansas. Ark. Expt. Sta. Bul. 750.

Brown, C. J., Carl Lueker, and L. O. Brown. 1969. Performance of bulls on Arkansas Cooperative Beef Bull Test 7. Ark. Expt. Sta. Rpt. Series 180.

Wright, O. E. and C. J. Brown. 1970. Feed conversion of Hereford and Angus bulls. J. Animal Sci. 30:333. (Abstr.).

Wingert, S. J. 1970. Some genetic aspects of the growth curves of Angus cows. M. S. Thesis. University of Arkansas Library, Fayetteville.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Arkansas

Location		Main Stn.	Main Stn.	Main Stn.		
Breed of sire		Angus	Hereford	A, H, C, S		
Breed of dam		Angus	Hereford	A & H		
Line or group[1]		Purebred	Purebred	Cross		
Percent used in project		100	100	100		
Inventory as of July 1, 1970	Cows 2 years and over	192	109	78		
	Yearling heifers	47	26	4		
	Bulls and steers under 1 year	66	29	38		
	Heifers under 1 year	49	36	35		
	Bulls over 1 year	36	33	0		
	Steers over 1 year	3	2	16		
Repro. perf.	Percent pregnant[2]	92	84	77		
	Calf survival percent[3]	94	88	95		
Wean perf.	Adj. ADG[4]	1.63	1.53	1.74		
	Av. type sc.[5]	13.0	12.4	12.2		
Postweaning performance	No. of bulls	46	36	0		
	No. of heifers	47	26	0		
	No. of steers	0	0	0		
Slaughtered	No. of bulls	18	10	0		
	No. of heifers	3	3	0		
	No. of steers	0	0	13		
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

S-10-1 (Rev.)
4-70

UNIVERSITY OF FLORIDA
Agricultural Experiment Station
Gainesville, Florida

I. PROJECT: 627 (Revised)

Pasture programs and cattle breeding systems for beef production on flatwoods soils of Northcentral Florida.

II. OBJECTIVES:

1. To determine the relative cost of three pasture programs for beef production with a cow-calf operation.

2. To compare the effectiveness of four different breeding systems in improving the production of beef cattle.

3. To evaluate systems for growing heavy calves to market weight and grade.

III. PERSONNEL:

M. Koger, W. G. Blue, G. B. Killinger, J. M. Myers and R. E. L. Greene

IV. ACCOMPLISHMENTS DURING THE YEAR:

Two hundred forty-seven females of breeding age were used during 1968-1969 in evaluating four breeding programs which were initiated in 1957 with a foundation of Brahman-Native females:

1. Upgrading to British sire (Angus and Hereford)

2. Crisscrossing Angus and Hereford

3. Crisscrossing Angus and Brahman

4. Crisscrossing Hereford and Santa Gertrudis

Weaning data from the 1969 calf crop are presented in form S-10-1.

V. FUTURE PLANS:

Present procedures will be continued until breed composition becomes stable enough to evaluate the programs. The data from feeding steers produced in the four programs will be summarized for presentation.

VI. PUBLICATIONS DURING THE YEAR:

Koger, M. Management-Grazing Systems. Coastal Plains Experiment Station Beef Cattle Shortcourse. Tifton, Georgia. June 1970.

VII. PUBLICATIONS PLANNED:

Station bulletin summarizing data from 1960-1964 in press.

EVERGLADES EXPERIMENT STATION
Belle Glade, Florida

I. PROJECT: 922

Angus, Brangus and Angus x Brangus crossbreds for beef production in the Everglades area.

II. OBJECTIVES:

1. To compare the performance of straightbred Angus and Brangus cattle with rotation crosses of the two breeds for beef production in the Everglades area.

2. To develop a highly productive herd of cattle at the Glades Correctional Institution through selection based on production testing.

III. PERSONNEL:

J. R. Crockett, D. W. Beardsley and M. Koger

IV. ACCOMPLISHMENTS DURING THE YEAR:

These were 1027 females of breeding age in the project. Blood composition has not stabilized to the point that performance of different breed groups can be evaluated with confidence.

V. FUTURE PLANS:

Increased selection pressure is to be initiated in order to speed up stabilization of breed composition of different groups.

VI. PUBLICATIONS:

None

VII. PUBLICATIONS PLANNED:

None

EVERGLADES EXPERIMENT STATION
Belle Glade, Florida

I. PROJECT: 990

Breeding beef cattle for adaptation to South Florida conditions.

II. OBJECTIVES:

1. To compare the performance of progeny of Angus, Brahman and Hereford cattle, and from three possible two-breed rotational crosses of these breeds for beef production in the South Florida area.

2. To develop through selection, Angus and Hereford cattle which will be adapted to South Florida conditions.

III. PERSONNEL:

J. R. Crockett, D. W. Beardsley and M. Koger

IV. ACCOMPLISHMENTS DURING THE YEAR:

There were 419 females of breeding age in the project. Data from this project are shown in form S-10-1.

V. FUTURE PLANS:

Continue project as outlined. Study grazing habits and forage intake of the different breed groups.

VI. PUBLICATIONS:

Gonzalez-Padilla, E., J. R. Crockett, M. Koger and D. E. Franke. 1969. Straightbred vs criss-cross breeding systems in South Florida. J. Animal Sci. 29:107. (Abstr.)

VII. PUBLICATIONS PLANNED:

None

UNIVERSITY OF FLORIDA
Agricultural Experiment Station
Gainesville, Florida

I. PROJECT: 1003

Inherent body size in cattle as related to adaptation to Florida's climatic environment.

II. OBJECTIVES:

To determine the performance of three different groups of beef cattle selected respectively for:

1. Large skeletal and body size

2. Adaptation to Florida climate as reflected in thrift and vitality, and

3. The combination of weight and grade to give the greatest economic returns per animal unit.

III. PERSONNEL:

M. Koger, F. S. Baker and A. C. Warnick

IV. ACCOMPLISHMENTS DURING THE YEAR:

Two groups of 450 cows each are being used in a selection experiment. One group is being selected for large skeletal size to determine the effect this trait has on adaptability to Florida. Another group is being selected for indications of adaptability, measured mainly by condition score to determine whether animals selected for this trait tend toward any particular size. The project has not been under way long enough for the groups to become distinct.

V. FUTURE PLANS:

Continue project as outlined.

VI. PUBLICATIONS DURING THE YEAR:

None

VII. PUBLICATIONS PLANNED:

None

RANGE CATTLE EXPERIMENT STATION
Ona, Florida

I. PROJECT: 1120

Charolais, Brahman, Angus and their crosses for beef production in South Florida.

II. OBJECTIVES:

To evaluate the relative productivity of Charolais, Brahman, Angus and their crosses for beef production in South Florida.

III. PERSONNEL:

F. M. Peacock, E. M. Hodges, H. L. Chapman and M. Koger

IV. ACCOMPLISHMENTS DURING THE YEAR:

Angus, Brahman and Charolais bulls are being mated to females of the same breeds in all possible combinations to produce straightbred and crossbred progeny. The three groups of F_1 females likewise will be mated to the three breeds of bulls to produce backcross and three-breed cross progeny. A minimum of 90 straightbred females (10 per subgroup) are bred each year. A comparable number of crossbred females will be added to the project as they are produced. The post-weaning and feedlot performance of progeny produced in the trial are evaluated in a companion study. The fifth calf crop was weaned in 1968. The production data in 1968 are not presented because breed groups and environment were confounded due to drought.

V. FUTURE PLANS:

Continue project as outlined.

VI. PUBLICATIONS DURING THE YEAR:

Preliminary report presented at short course.

VII. PUBLICATIONS PLANNED:

None

NORTH FLORIDA EXPERIMENT STATION
Quincy, Florida

I. PROJECT: 1180

Selection of replacement females in beef cattle.

II. OBJECTIVES:

To compare genetic progress and economic returns from selecting replacements on their own calfhood performance versus selection on the basis of production records.

III. PERSONNEL:

F. S. Baker, Jr. and M. Koger

IV. ACCOMPLISHMENTS DURING THE YEAR:

The 1969 calf crop represented the fourth year's production following the initiation of the selection procedures outlined for females. The weaning data from the 1969 calf crop is summarized in form S-10-1.

V. FUTURE PLANS:

Continue project as outlined.

VI. PUBLICATIONS DURING THE YEAR:

None

VII. PUBLICATIONS PLANNED:

None

EVERGLADES EXPERIMENT STATION
Belle Glade, Florida
(Project located at Brighton Seminole Indian Reservation)

I. PROJECT: 1263

Selection for maternal ability in beef cattle.

II. OBJECTIVES:

1. To compare maternal ability and individual excellence in weight and grade at 20 months of age as selection criteria in improvement of beef cattle.

2. To produce herd sires from adapted Hereford cattle for use in tribal herds.

III. ACCOMPLISHMENTS DURING THE YEAR:

There are 353 breeding age females in the project. The data are shown in form S-10-1.

IV. FUTURE PLANS:

Continue project as outlined.

V. PUBLICATIONS DURING THE YEAR:

None

VI. PUBLICATIONS PLANNED:

None

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Florida

		Range Cattle Station	Range Cattle Station	Range Cattle Station	Range Cattle Station	Range Cattle Station
Location		Range Cattle Station	Range Cattle Station	Range Cattle Station	Range Cattle Station	Range Cattle Station
Breed of sire		Angus	Brahman	Charolais	A,B & C	A,B & C
Breed of dam		Angus	Brahman	Charolais	A,B & C	F_1
Line or group[1]		Pure A	Pure B	Pure C	F_1 Calves	Backcross 3-breed
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over	12	12	12	72	108
	Yearling heifers	3	3	3	13	18
	Bulls and steers under 1 year	5	4	5	28	44
	Heifers under 1 year	5	5	4	29	44
	Bulls over 1 year	3	3	3	-	-
	Steers over 1 year	0	0	0	0	0
Repro. perf.	Percent pregnant[2]	70	85	76	80	93
	Calf survival percent[3]	100	91	77	78	86
Wean perf.	Adj. ADG[4]	1.56	1.65	2.06	1.90	1.96
	Av. type sc.[5]	11	10	11	11	11
Postweaning performance	No. of bulls	0	0	0	0	0
	No. of heifers	0	0	0	0	0
	No. of steers	4	4	4	24	12
Slaughtered	No. of bulls	0	0	0	0	0
	No. of heifers	0	0	0	0	0
	No. of steers	4	4	4	24	12
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

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Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Florida

Location		Quincy	Quincy		Raiford	
Breed of sire		Angus	Angus		Angus	
Breed of dam		Angus	Angus		Gr. Angus	
Line or group[1]		Maternal Ability	Control		Combined[a]	
Percent used in project		50	50		100[b]	
Inventory as of July 1, 1970	Cows 2 years and over	49	45		926	
	Yearling heifers	15	15		350	
	Bulls and steers under 1 year	12	11		271	
	Heifers under 1 year	16	15		274	
	Bulls over 1 year	14	15		45	
	Steers over 1 year	0	0		0	
Repro. perf.	Percent pregnant[2]	86	76			
	Calf survival percent[3]	94	93			
Wean perf.	Adj. ADG[4]	1.77	1.78		1.56	
	Av. type sc.[5]	11	11		10	
Postweaning performance	No. of bulls	12	11		0	
	No. of heifers	16	15		0	
	No. of steers	0	0		0	
Slaughtered	No. of bulls	0	0		0	
	No. of heifers	0	0		0	
	No. of steers	0	0		0	
Remarks	[a]Groups combined [b]Cattle owned by cooperator					

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Florida - Belle Glade

Location		Brighton	Brighton	GCI	GCI	GCI
Breed of sire		Hereford	Hereford	Angus	Angus & Brangus	Brangus
Breed of dam		Hereford	Hereford	Angus	Crossbreds	Brangus
Line or group[1]				Angus	A-Bg Rotation	Brangus
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over	178	175	133	611	284
	Yearling heifers	64	42	50	185	74
	Bulls and steers under 1 year	57	56	38	176	88
	Heifers under 1 year	58	58	50	185	74
	Bulls over 1 year	47	58	6	30	14
	Steers over 1 year	-	-	37	176	38
Repro. perf.	Percent pregnant[2]	97	86	90	85	74
	Calf survival percent[3]	94	83	88	82	69
Wean perf.	Adj. ADG[4]	1.68	1.67	1.29	1.53	1.53
	Av. type sc.[5]	11	11	10	11	10
Postweaning performance	No. of bulls	-	-	-	-	-
	No. of heifers	64	42	50	185	74
	No. of steers	-	-	-	-	-
Slaughtered	No. of bulls	-	-	-	-	-
	No. of heifers	-	-	-	-	-
	No. of steers	-	-	-	-	-
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

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Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Florida - Belle Glade

Location		Belle Glade	Belle Glade	Belle Glade		
Breed of sire		A	B	H		
Breed of dam		A	B	H		
Line or group[1]		Angus	Brahman	Hereford		
Percent used in project						
Inventory as of July 1, 1970	Cows 2 years and over	38	37	46		
	Yearling heifers [6]	10	10	11		
	Bulls and steers under 1 year	15	14	15		
	Heifers under 1 year	15	13	16		
	Bulls over 1 year	8	6	9		
	Steers over 1 year [6]	17	9	18		
Repro. perf.	Percent pregnant[2]	89	62	93		
	Calf survival percent[3]	74	45	87		
Wean perf.	Adj. ADG[4]	1.82	1.82	1.63		
	Av. type sc.[5]	12	10	12		
Postweaning performance	No. of bulls	-	-	-		
	No. of heifers	10	10	11		
	No. of steers	6	6	6		
Slaughtered	No. of bulls	-	-	-		
	No. of heifers	-	-	-		
	No. of steers	6	6	6		
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.
6 - 1969

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Production, Inventory, and Performance Data, S-10 Herds -

State Florida - Belle Glade

Location		Belle Glade	Belle Glade	Belle Glade		
Breed of sire		A-B	A-H	B-H		
Breed of dam		BA-AB	HA-AN	HB-B		
Line or group[1]		A-B Rotation	A-H Rotation	B-H Rotation		
Percent used in project						
Inventory as of July 1, 1970	Cows 2 years and over	84	92	90		
	Yearling heifers	36	33	33		
	Bulls and steers under 1 year	30	30	30		
	Heifers under 1 year	30	31	32		
	Bulls over 1 year	2	0	2		
	Steers over 1 year[6]	23	32	31		
Repro. perf.	Percent pregnant[2]	82	92	86		
	Calf survival percent[3]	75	87	78		
Wean perf.	Adj. ADG[4]	2.03	1.79			
	Av. type sc.[5]	11	12	11		
Postweaning performance	No. of bulls	-	-	-		
	No. of heifers	36	33	33		
	No. of steers	12	12	12		
Slaughtered	No. of bulls	-	-	-		
	No. of heifers	-	-	-		
	No. of steers	12	12	12		
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.
6 - 1969

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Florida

		Beef Res. Unit	Beef Res. Unit	Beef Res. Unit	Beef Res. Unit	
Location						
Breed of sire		A & H	A & H	A & B	H & SG	
Breed of dam		A & H	HA & AH	BA & AB	SGH & HSG	
Line or group[1]		Grades	A-H Crisscross	A-B Crisscross	H-SG Crisscross	
Percent used in project		50	50	50	50	
Inventory as of July 1, 1970	Cows 2 years and over	63	62	65	57	
	Yearling heifers	20	21	20	13	
	Bulls and steers under 1 year	23	23	20	17	
	Heifers under 1 year	23	23	21	18	
	Bulls over 1 year	3	3	3	3	
	Steers over 1 year	0	0	0	0	
Repro. perf.	Percent pregnant[2]	88	92	89	72	
	Calf survival percent[3]	94	90	82	92	
Wean perf.	Adj. ADG[4]	1.92	1.96	2.13	2.18	
	Av. type sc.[5]	12	12	12	12	
Postweaning performance	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	19	25	20	20	
Slaughtered	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	19	25	20	20	
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

BROOKSVILLE BEEF CATTLE RESEARCH STATION
Brooksville, Florida

I. PROJECT: Work Unit No. 03-30-013-10-03 -27-04 State Project 1186

A study of response to selection and genetic-environmental interaction in genetically similar groups of Hereford cattle at two locations (Miles City, Montana and Brooksville, Florida).

II. OBJECTIVES:

1. To determine whether originally genetically similar groups of cattle bred and selected for several generations according to the same criteria in the two markedly different environmental conditions of Miles City, Montana and Brooksville, Florida become genetically different or remain similar.

2. To estimate the importance of genetic-environmental interaction within a British breed of beef cattle.

3. To determine the importance of adaptation to a specific location if maximum productivity is to be attained.

III. PERSONNEL:

Project committee composed of the following persons: Representatives of the Florida and Montana Agricultural Experiment Stations as designated by the respective directors; Superintendents of the Miles City and Brooksville stations, plus not more than one additional person from each station; the W-1 and S-10 Regional Coordinators; and the Chief of the Beef Cattle Research Branch, U. S. Department of Agriculture (Chairman).

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. The seventh calf crop has been weaned.

2. Performance of G.E.I. cattle in 1969 was as follows:

Line	Calf Survival	Wean Rate	Wean Weight	Wean Age	Adj. Weight	Cond. Score	% Preg. Cows	% Preg. Heifers
4	84	75	375	220	365	9	81	83
5	88	78	316	215	319	8	53	80
6	95	77	429	220	426	10	93	92

3. Milk production was initiated with one years results of three milkings as follows: The three milkings were in April, June and August.

Line	No. Cows	Average Milk Production (lbs)
4	51	5.77 ± .48
5	14	5.38 ± .61
6	39	5.46 ± .46

V. FUTURE PLANS:

Continue on the project outline.

VI. PUBLICATIONS DURING THE YEAR:

A seven year summary of the performance of G.E.I. cattle at Miles City, Montana and Brooksville, Florida, is being circulated for approval.

VII. PUBLICATIONS PLANNED:

None.

I. PROJECT: State Project 1245

Three months versus twelve months breeding season for beef cattle.

II. OBJECTIVES:

To compare the reproductive and weaning performance of Brahman and Santa Gertrudis cows bred during three-month and continuous 12-month breeding seasons.

III. PERSONNEL:

Leaders:

A. C. Warnick, Florida Experiment Station, Gainesville, Florida
M. Koger, Florida Experiment Station, Gainesville, Florida
W. C. Burns, U. S. Department of Agriculture, Brooksville, Florida

Cooperators:

S-10 Coordinator, U. S. D. A.

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. This project was terminated in 1969.

2. Performance of the Brahman and Santa Gertrudis cattle for 1969 is as follows:

	Calf Survival	Wean Rate	Wean Wt.	Wean Age	Adj. Wt.	Cond. Score	Preg. Rate	Number Cows
Bra-90 days	100	91	407	208	422	8	59	22
Bra-365 days	81	65	410	195	446	8	68	19
S.G.-90 days	90	69	495	205	532	9	52	25
S.G.-365 days	100	72	470	206	504	8	29	24
90 days	95.0	80.0	451	206	477	8.5	55.5	47
365 days	90.05	68.5	440	200	475	8.0	48.5	43

The performance of the cattle in the 90 day breeding period in 1969 was better in all aspects than in year-round breeding program.

V. FUTURE PLANS:

Research on Santa Gertrudis has been discontinued. These cattle were sold last fall and the proceeds used to purchase 88 head of grade Brahman cattle.

VI. PUBLICATIONS DURING THE YEAR:

A publication is being circulated now for final approval.

VII. PUBLICATIONS PLANNED:

None

I. PROJECT:

Miscellaneous project on Angus cows.
Milk production and twinning.

II. OBJECTIVES:

1. Milk production

To determine levels of milk production in Angus cattle and to correlate the amount of milk to production traits.

2. Twinning

Synchronize estrus and induce twinning by implanting norethandrolone implants and injecting FSH.

III. PERSONNEL:

Dr. Marvin Koger, University of Florida, Gainesville, Florida, Dr. A. C. Warnick, University of Florida, Gainesville, Florida, James Dickey, Graduate Fellow, University of Florida, Gainesville, Florida, A. C. Mills, Graduate Fellow, University of Florida, Gainesville, Florida, W. C. Burns, Superintendent, Brooksville Beef Cattle Research Station, Brooksville, Florida

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Milk production

A year's milk production on 119 Angus cows was obtained in April, June and August. The average milk production for the summer was $5.89 \pm .17$ pounds. This compares with $5.54 \pm .45$ pounds for the Herefords.

2. Twinning

Sixty cows were synchronized and injected with FSH. Only 5 cows came in heat during the 5 day interval that all cows were supposed to be in heat and two of the 5 cows repeated at a later date. A big percentage of the cows came in heat between the 18th and 26th day.

V. FUTURE PLANS:

Continue to obtain milk production on the Angus cows and get a formal breeding project approved. Future plans on twinning have not been determined at this time.

VI. PUBLICATIONS:

None

VII. PUBLICATIONS PLANNED:

None

I. PROJECT:

Miscellaneous projects.
Wintering program on Angus cows.

II. OBJECTIVES:

To determine the value of Sorgum silage, grass hay, cottonseed pellets and non-protein nitrogen pellet in wintering Angus cows.

III. PERSONNEL:

Dr. Clarence Ammerman, University of Florida, Gainesville, Florida
W. C. Burns, Superintendent, Brooksville Beef Cattle Research Station, Brooksville, Florida

IV. ACCOMPLISHMENTS DURING THE YEAR:

Three years data indicate there is no difference in the performance of Angus cows in weight change, conception rate and weaning weight in the four wintering programs.

V. FUTURE PLANS:

Terminate the existing study and revise the wintering program to extend through all or part of the breeding season.

VI. PUBLICATIONS:

None

VII. PUBLICATIONS PLANNED:

The performance of Angus cattle on four wintering programs.

I. PROJECT:

Introduction of germ plasm from highly productive grades as a tool for genetic improvement of cattle.

II. OBJECTIVES:

1. To select highly productive cows with Brahman characteristics from commercial herds and assess their breeding values for reproductive efficiency and calf survival, as compared with those of purebred Brahmans.

2. To determine how much of any superiority of the selected grades is retained following an additional topcross with Brahman bulls.

3. To compare the combining ability of Brahman and grade bulls with British (Angus) females as a measure of their utility for crossbreeding.

III. PERSONNEL:

Dr. Marvin Koger, University of Florida, Gainesville, Florida
Dr. Donald E. Franke, University of Florida, Gainesville, Florida
Dr. Will T. Butts, USDA-ARS, Knoxville, Tennessee
W. C. Burns, USDA-ARS, Brooksville, Florida

IV. ACCOMPLISHMENTS DURING THE YEAR:

Eighty-eight head of four year old, pregnant, grade Brahman cattle were purchased last fall. These cattle are being bred this year, along with the purebred Brahman, to five Brahman bulls. Three of the bulls were from private breeders. The cattle wintered good and they should have a good conception rate the first year of the project.

V. FUTURE PLANS:

Follow project outline.

VI. PUBLICATIONS:

None

VII. PUBLICATIONS PLANNED:

None

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Florida

Location		Brooksville	Brooksville	Brooksville		
Breed of sire		Angus	Brahman	Brahman		
Breed of dam		Angus	Brahman	Brahman		
Line or group[1]		Purebred	Purebred	Grade		
Percent used in project		100	100	100		
Inventory as of July 1, 1970	Cows 2 years and over	171	46	88		
	Yearling heifers	60	14	-		
	Bulls and steers under 1 year	81	8	43		
	Heifers under 1 year	65	15	41		
	Bulls over 1 year	67	28	-		
	Steers over 1 year	-	-	-		
Repro. perf.	Percent pregnant[2]	88	63	-		
	Calf survival percent[3]	92	90	-		
Wean perf.	Adj. ADG[4]	1.73	2.13	-		
	~~Av. type sc.~~[5]	~~"Only Slaughter & Feeder Scores Taken"~~				
Postweaning performance	No. of bulls	58	22	-		
	No. of heifers	60	14	-		
	No. of steers	-	-	-		
Slaughtered	No. of bulls	-	-	-		
	No. of heifers	-	-	-		
	No. of steers	-	-	-		
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: Sex and age of dam.

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Florida

Location		Brooksville	Brooksville	Brooksville		
Breed of sire		Hereford	Hereford	Hereford		
Breed of dam		Hereford	Hereford	Hereford		
Line or group[1]		Line 4	Line 5	Line 6		
Percent used in project		100	100	100		
Inventory as of July 1, 1970	Cows 2 years and over	94	21	52		
	Yearling heifers	20	8	16		
	Bulls and steers under 1 year	29	5	19		
	Heifers under 1 year	28	7	13		
	Bulls over 1 year	39	8	27		
	Steers over 1 year	-	-	-		
Repro. perf.	Percent pregnant[2]	81	53	93		
	Calf survival percent[3]	84	88	95		
Wean perf.	Adj. ADG[4]	1.66	1.48	1.94		
	~~Av. type sc.~~[5]	"Only Slaughter & Feeder Scores Taken"				
Postweaning performance	No. of bulls	33	6	24		
	No. of heifers	20	8	16		
	No. of steers	-	-	-		
Slaughtered	No. of bulls	6	5	4		
	No. of heifers	-	-	-		
	No. of steers	-	-	-		
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: Sex and age of dam.

5 - Suggest S-10 scoring system; indicate if different.

I. PROJECT: State 2-99 (S-10)

Selection of beef cattle for single items of importance in profitable beef production.

II. OBJECTIVES:

To obtain preliminary information on the relative effectiveness of selecting for a single character.

To observe trends in characters for which no selection is made when selection is for a single character.

III. PERSONNEL:

Hollis D. Chapman, T. M. Clyburn and W. C. McCormick

IV. ACCOMPLISHMENTS DURING THE YEAR:

Four herds of grade Polled Hereford females, owned and maintained by the Georgia State Prison Farm, Reidsville, are used to study selecting for (1) weaning weight, (2) rate of postweaning gain, (3) type score, and (4) average performance. For the latter group, replacements with records nearest average for each trait are selected. Bulls used in all four groups are selected from the Polled Hereford herd at Tifton. Weaning data for the 1969 calf crop are shown in tables 1 and 2.

Table 1. Weaning Data, Generation 1 Cows, 1969 Calf Crop

Herd	No. calves weaned	Avg. birth weight	ADG-birth to weaning	Weaning scores	
				Type	Condition
Average	20	74	1.47	9.7	7.9
Rate of gain	20	72	1.46	9.9	8.0
Score	22	68	1.50	10.4	8.3
Wean. weight	20	83	1.53	10.1	8.0

Table 2. Weaning Data, Generation 2 Cows, 1969 Calf Crop

Herd	No. calves weaned	Avg. birth weight	ADG-birth to weaning	Weaning scores	
				Type	Condition
Average	25	71	1.48	9.8	7.9
Rate of gain	16	72	1.52	10.0	8.2
Score	27	71	1.48	9.7	7.9
Wean. Weight	28	74	1.55	10.3	8.7

Fifty-three generation 2 steers randomly selected from within each sire-herd group in the 1968 calf crop were grazed and managed as a group until slaughtered in August 1969. The data by herds are shown in table 3.

Table 3. Growth and Carcass Data - Generation 2 Steers

Herd	No.	Post-wean. daily gain	Wt./ day of age	Carcass wt./day of age	Carcass grade	Area rib eye per cwt./ carcass	Rib eye fat, inches
Wean wt.	14	1.88	1.78	1.03	9.9	1.61	0.69
Rate of gain	14	1.97	1.76	1.01	9.6	1.80	0.65
Score	12	1.66	1.64	0.96	9.5	1.70	0.62
Average	13	1.70	1.67	0.96	9.7	1.82	0.69

V. FUTURE PLANS:

The project will be continued as outlined.

VI. PUBLICATIONS DURING THE YEAR:

Chapman, Hollis D., T. M. Clyburn and W. C. McCormick. 1970. Selection of Beef Cattle for Single Traits. J. Animal Sci. 29:225.

VII. PUBLICATIONS PLANNED:

A manuscript containing data from generation 1 cows (generation 2 animals) will be prepared during the next year or two.

I. PROJECT: Animal Husbandry 209, AHRD dl-3 (S-10)

A study of grading, crisscrossing and rotational crossing as breeding systems for commercial beef production.

II. OBJECTIVES:

To study the relative value of grading, crisscrossing and rotational crossing as breeding systems for commercial beef production.

To study heterotic effects in crosses between Angus and Polled Hereford breeds, as compared to heterosis in crosses between these breeds and Santa Gertrudis - a breed based partially on a Brahman foundation.

To study the comparative value of the Santa Gertrudis breed with the Angus and Polled Hereford breeds.

III. PERSONNEL:

Hollis D. Chapman, T. M. Clyburn and W. C. McCormick

IV. ACCOMPLISHMENTS DURING THE YEAR:

Weaning data for the 1969 calf crop raised by generation 1 cows are as shown in table 1.

Table 1. Weaning Data, 1969 Calves, Generation 1 Cows

Herd	Breeding system	No. calves born	Avg. birth wt.	ADG birth to weaning	Avg. type score	Avg. condition score
Gr. A	Grading-up	9	69	1.53	11.1	9.2
Gr. PH	Grading-up	8	66	1.46	9.8	7.8
Gr. SG	Grading-up	9	86	1.61	9.7	8.1
AxPH	Crisscrossing	13	71	1.57	10.1	8.5
AxSG	Crisscrossing	8	84	1.73	10.0	8.7
PHxSG	Crisscrossing	11	74	1.61	9.6	8.6
AxPHxSG	Rotational crossing	20	71	1.75	10.8	9.3

Weaning data for the 1969 calf crop raised by generation 2 animals are as shown in table 2.

Table 2. Weaning Data, 1969 Calves, Generation 2 Cows

Herd	Breeding system	No. calves born	Avg. birth wt.	ADG birth to weaning	Avg. type score	Avg. condition score
Gr. A	Grading-up	22	64	1.48	10.1	8.2
Gr. PH	Grading-up	32	69	1.58	10.0	8.1
Gr. SG	Grading-up	18	73	1.81	10.1	8.6
AxPH	Crisscrossing	33	69	1.65	10.4	8.6
AxSG	Crisscrossing	29	76	1.78	10.0	8.7
PHxSG	Crisscrossing	26	78	1.92	10.4	8.7
AxPHxSG	Rotational crossing	34	71	1.78	10.4	8.9

Tables 3 and 4 are summaries of progeny performance in generations 1 and 2, respectively. Table 3 contains information from backcross and three-breed cross calves while table 4 contains information from the first rotational cross calves of both the two- and three-breed rotational cross herds.

Table 3. Least-Squares Means by Herd, 1957-1962

				Postweaning				
							Carcass	
Herd	No.	Birth wt.,kg	Wean wt.,kg	No.	ADG kg	Slaughter wt.,kg	Wt.,kg	Score
Overall	1026	31	204	179	0.80	430	247	8.9
A	137	28	186	24	0.72	391	223	9.3
PH	146	32	184	24	0.82	413	230	8.2
SG	134	34	227	24	0.85	457	261	8.4
AxPH	147	30	195	23	0.80	419	240	9.0
AxSG	112	31	204	24	0.78	429	246	9.0
PHxSG	145	32	216	24	0.82	447	260	8.6
AxPHxSG	205	32	216	36	0.81	435	252	9.2

Table 4. Least-Squares Means by Herds, 1962-1967

				Postweaning				
							Carcass	
Herd	No.	Birth wt.,kg	Wean wt.,kg	No.	ADG kg	Slaughter wt.,kg	Wt.,kg	Score
Overall	865	30	197	180	0.74	417	238	9.0
A	105	27	181	24	0.66	374	212	9.4
PH	133	30	173	24	0.74	390	220	8.4
SG	98	32	215	24	0.74	433	249	8.5
AxPH	136	28	184	24	0.70	393	224	9.1
AxSG	113	29	204	24	0.73	425	243	9.1
PHxSG	123	32	210	24	0.77	426	243	8.9
AxPHxSG	157	32	214	36	0.76	439	252	9.1

V. FUTURE PLANS:

The studies will be continued as planned.

VI. PUBLICATIONS DURING THE YEAR:

Routine annual reports.

VII. PUBLICATIONS PLANNED:

A manuscript (Grading, Two- and Three-Breed Rotational Crossing As Systems for Production of Calves to Weaning) has been submitted to the Journal of Animal Science for publication. A manuscript based on post-weaning data is now being prepared.

GEORGIA COASTAL PLAIN EXPERIMENT STATION
Tifton, Georgia

I. PROJECT: Animal Husbandry 224, AHRD d1-3 (S-10)

Improvement of performance and carcass quality in beef cattle through selection.

II. OBJECTIVES:

To develop herds of Polled Hereford and Angus cattle with superior performance.

To progeny test Polled Hereford and Angus sires with selection criteria based primarily on pre- and postweaning growth rate, and carcass meatiness and tenderness.

III. PERSONNEL:

Hollis D. Chapman and W. C. McCormick

IV. ACCOMPLISHMENTS DURING THE YEAR:

The Polled Hereford herd of 108 females was mated naturally with five Polled Hereford sires. The Angus females (59) were bred naturally to two Angus and artificially to one Angus bull. The calves from these matings were born from January to March 1969.

In late July 1969, the cows were grouped according to the sex of their calf and pastured so that bull calves would have access to creep feed until weaning on September 9, 1969. At that time they were placed on a 168-day postweaning gain test. At weaning, prospective female replacements were selected and fed to gain about 1.25 lb. per day until small grain pasture was available in mid-December. The postweaning performance of heifers was recorded under this "limited feed-winter pasture" system. No grain was fed once winter pasture was available. The remaining heifers (35% of the Polled Herefords; 44% of the Angus) were fed a grain ration for 168-days and sold for slaughter.

Table 1 is a summary of 168-day ADG of bulls by breed and sire. Table 2 lists the records of the young bulls selected from the Polled Hereford group to be used in the breeding research work.

Table 1. Postweaning Performance of Young Bulls - 1969 Calves

Breed	Sire	No. bulls	205-day wt., lb.	Feedlot ADG.lb.	Final age	WPDA lb.	Type score
PH	195	5	408	3.07	399	2.41	12.3
PH	316	7	411	3.00	390	2.46	12.8
PH	367	14	427	2.95	401	2.44	12.3
PH	615	7	466	3.14	396	2.56	12.9
PH	677	6	405	2.76	396	2.21	11.5
A	517	2	434	2.92	354	2.49	12.2
A	601	8	396	2.68	388	2.19	11.7
A	934	14	435	2.89	391	2.45	12.2

Table 2. Records of Bulls Selected to be Used in Breeding Research

Bull	Sire	205-day wt., lb.	168-day ADG, lb.	Yearling WPDA, lb.	Yearling Type score	Herd to be used in
927	367	527	3.21	2.88	12	Tifton
943	615	483	3.56	2.83	14	Tifton
976	316	·445	3.12	2.61	14	Reidsville, Type Herd
965	615	540	2.76	2.60	13	Reidsville, Wean Wt. Herd
935	367	388	3.36	2.52	13	Reidsville, ADG Herd
927	316	424	2.98	2.46	12	Reidsville, Avg. Herd
Average of 40 Contemporaries		425	2.98	2.45	12	

V. FUTURE PLANS:

The project is being considered for revision.

VI. PUBLICATIONS DURING THE YEAR:

Chapman, Hollis D., R. S. Lowrey and W. C. McCormick, 1970. Hay and Oats Pasture for Wintering Beef Cows. Georgia Agricultural Research. Vol. 2, No. 2, P. 15.

Routine annual reports.

VII. PUBLICATIONS PLANNED:

Pending on the review of the data collected since 1936. Analyses are planned and a station publication will follow if deemed appropriate.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Georgia

	Location	Reidsville	Reidsville		Tifton	Tifton
	Breed of sire	PH, SG	A, PH, SG		PH	A
	Breed of dam	PH x SG	AxPHxSG		PH	A
	Line or group[1]	Crisscross	Rotational Cross		Purebred	Purebred
	Percent used in project	100	100		80	80
Inventory as of July 1, 1970	Cows 2 years and over	44	72		91	45
	Yearling heifers	14	30		30	9
	Bulls and steers under 1 year	11	24		40	18
	Heifers under 1 year	13	25		42	19
	Bulls over 1 year	**	**		5	2
	Steers over 1 year	0	0		0	0
Repro. perf.	Percent pregnant[2]	84	91		91	86
	Calf survival percent[3]	97	98		96	93
Wean perf.	Adj. ADG[4]	1.82	1.77		1.71*	1.69*
	Av. type sc.[5]	10.2	10.5		12.2	11.9
Postweaning performance	No. of bulls	0	0		39	23
	No. of heifers	0	0		46	16
	No. of steers	0	0		0	0
Slaughtered	No. of bulls	0	0		7	7
	No. of heifers	0	0		16	7
	No. of steers	0	0		0	0
	Remarks					

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: *Sex (to steer basis) age and age of dam.

5 - Suggest S-10 scoring system; indicate if different.
**Same bulls used in three grade groups.

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Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Georgia

	Location	Reidsville	Reidsville	Reidsville	Reidsville	
	Breed of sire	PH	PH	PH	PH	
	Breed of dam	Gr. PH	Gr. PH	Gr. PH	Gr. PH	
	Line or group[1]	Wean wt.	Rate gain	Type	Average	
	Percent used in project	100	100	100	100	
Inventory as of July 1, 1970	Cows 2 years and over	58	48	58	62	
	Yearling heifers	27	20	25	23	
	Bulls and steers under 1 year	20	22	19	19	
	Heifers under 1 year	21	20	25	20	
	Bulls over 1 year	2	2	2	2	
	Steers over 1 year	19	15	23	20	
Repro. perf.	Percent pregnant[2]	85	71	93	91	
	Calf survival percent[3]	96	97	89	86	
Wean perf.	Adj. ADG[4]	1.54	1.49	1.49	1.48	
	Av. type sc.[5]	9.9	10.0	10.0	9.8	
Postweaning performance	No. of bulls	0	0	0	0	
	No. of heifers	25	19	20	26	
	No. of steers	12	12	12	12	
Slaughtered	No. of bulls	0	0	0	0	
	No. of heifers	0	0	0	0	
	No. of steers	14	14	12	13	
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Georgia

Location		Reidsville	Reidsville	Reidsville	Reidsville	Reidsville
Breed of sire		a	PH	SG	A.PH	A.SG
Breed of dam		Gr.A	Gr.PH	Gr.SG	A x PH	A x SG
Line or group[1]		Grade	Grade	Grade	Crisscross	Crisscross
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over	41	45	42	52	47
	Yearling heifers	13	18	14	17	15
	Bulls and steers under 1 year	19	21	18	21	22
	Heifers under 1 year	14	15	12	20	16
	Bulls over 1 year	4	4	4	*	*
	Steers over 1 year	0	0	0	0	0
Repro. perf.	Percent pregnant[2]	87	87	73	94	86
	Calf survival percent[3]	84	97	96	93	97
Wean perf.	Adj. ADG[4]	1.49	1.56	1.74	1.62	1.77
	Av. type sc.[5]	10.4	10.0	10.0	10.2	10.0
Postweaning performance	No. of bulls	0	0	0	0	0
	No. of heifers	0	0	0	0	0
	No. of steers	0	0	0	0	0
Slaughtered	No. of bulls	0	0	0	0	0
	No. of heifers	0	0	0	0	0
	No. of steers	0	0	0	0	0
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments: **None**

5 - Suggest S-10 scoring system; indicate if different.

*** - Some bulls indicated in Grade Herds.**

S-10-1 (Rev.)
4-70

UNIVERSITY OF KENTUCKY
Agricultural Experiment Station
Lexington, Kentucky

I. PROJECT: Animal Science 260 (S-10) (Revised)

Selection for increased growth rate in beef cattle.

II. OBJECTIVES:

To use growth rate as a single criteria for selection when measured at a year of age.

To investigate phenotypic and genetic relationships between various preweaning and postweaning performance traits, preweaning and postweaning conformation scores, and carcass traits.

To compare heritabilities of and the phenotypic and genetic correlations among various preweaning and postweaning performance traits, preweaning and postweaning conformation scores, and carcass traits when the estimates are obtained from two populations where the criteria of selection is different for each population.

III. PERSONNEL:

F. A. Thrift and J. D. Kemp

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Initiation of the revised project.

The project was revised in 1969 and 233 purebred Hereford cows, represented by 40 sires, were randomly allotted into two groups (Control, line 2; Select, line 4), on the basis of sire and age. The average age for each of the two lines was 4.6 years. A total of 20 bulls are being used as foundation sires for the selection experiment. Three of the foundation sires came from the 07 Ranch, Bronco, Texas, and two from the R. W. Jones Farm, Leslie, Georgia. The remaining 15 sires were reared at the Kentucky Station, with three of the bulls being sired artificially through the use of semen furnished by the Fort Robinson Station, Crawford, Nebraska. These foundation sires will be used during the three-year period, 1969 through 1971, and thereafter, will be replaced by their selected sons according to the project outline.

2. Breeding, calving, and culling of cows.

During a 75-day breeding season (April 15 to July 1), in 1969, 233 females (45 heifers and 188 cows), were exposed to nine of the foundation sires, with females from the two lines being bred to each of the foundation sires. Of the 233 females exposed, 227 were present in the herd when the calves were weaned in late September. Twenty-five of these 227 females (7 heifers and 18 cows), were culled at the time the calves were weaned. Of the 18 cows culled, two were culled for cancer eye and one for a bad udder. The

remaining 15 cows and seven heifers were not pregnant, as examined by rectal palpation. On January 1, 1970, there were 36 of the heifers and 166 of the cows available to calve. One of the 36 heifers and eight of the 166 cows did not calve. These nine females together with four older cows that had lost calves two successive years were culled. Of the 35 heifers and 158 cows that calved, 14 (40%), and 13 (8%), of the calves were lost at birth or shortly thereafter from the heifers and cows, respectively. These death losses are lower than for 1969, but are still considered to be very high. Part of the calf death losses from the heifers and cows was due to leptospirosis, even though all females had been vaccinated for this disease. Also, six of the 27 calves were lost during one weekend due to subzero, rainy weather.

3. Selection of replacements.

There were 143 calves (59 bulls and 81 heifers), reared that were born during the 1969 calving season, and these were weaned on September 23, 1969, at an average age of 231 days. Approximately ten days after weaning, the bulls were placed on a 168-day postweaning feeding test; whereas, the heifers remained on pasture until November 1 at which time they received corn silage *ad libitum* and enough supplemental shelled corn and soybean meal to gain 1.0 - 1.25 pounds per day during the remainder of the 168-day test period. The postweaning feeding test was concluded on March 10, 1970, and six of the 59 bulls were selected on the basis of their growth performance for possible use in the herd as foundation sires for the revised project. All 81 of the heifers were retained as replacements and were randomly allotted to the two lines on a within-sire basis. A comparison of the growth performance of the six selected bulls with the growth performance of all 59 bulls is presented in table 1.

4. Collection of carcass data.

After the six bulls were selected, 49 of the remaining bulls were slaughtered and routine carcass data obtained. These data will be pooled with previously collected carcass data to determine the relationships between various preweaning, postweaning, and carcass traits of young bulls.

5. Analysis of blood data.

From 24 bulls and 24 heifers born in 1968, blood samples were collected immediately after completion of the 160-day postweaning feeding test. The bulls and heifers were separated into high- (12 bulls, 12 heifers), and low-gaining (12 bulls, 12 heifers), groups on the basis of their 365-day weight, and various blood traits were analyzed to see if these traits differ for the high- and low-gaining groups. Data were analyzed separately for bulls and heifers since the bulls received a concentrate ration and the heifers were fed silage during the postweaning test period. The analyses of variance for the growth and blood traits are presented in table 2, and least squares means are presented in table 3. None of the blood traits were significantly different for the high- and low-gaining bulls and heifers. Additional blood samples were collected from calves born in 1969 halfway between birth and weaning, at

weaning, halfway between weaning and completion of the 168-day postweaning feeding test, and at the termination of the 168-day postweaning test. These data will be analyzed to see how the blood components change with age.

6. Fire and freeze branding of all females.

Over a three-week period in April 1969, 200 Hereford females ranging in age from 15 months (replacement heifers), to ten years, were branded with their individual herd numbers on each side of the rib cage just behind the shoulder with either freeze or fire brands. Five-inch copper-tipped irons were used for the fire branding, and five-inch copper freeze branding irons were used for the freeze branding. The fire brands were heated using a regular butane branding iron heater, and the freeze brands were chilled in dry ice and 95% ethyl alcohol 45 to 60 minutes before being used. Prior to freeze or fire branding, hair on the rib cage just behind the shoulder was clipped and excess "scurf" removed from the clipped area with a stiff brush. For the side of each cow that was freeze branded, the clipped area was wetted with a sponge dipped in 95% ethyl alcohol, and the freeze brands were applied immediately for a duration of 50 to 55 seconds. The brands were evaluated first for legibility by one person on January 14, 1970, just prior to the beginning of the 1970 calving season. The brands were evaluated by another person from horseback three weeks later as the cows grazed on pasture. An average of the two scores was taken as the score for each brand. The following scoring system was used to evaluate the brands: 1 = no visible numbers; 2 = visible numbers, but illegible; 3 = incomplete numbers, but able to understand after study; 4 = easily recognizable numbers, but with breaks or unbranded areas; 5 = instantly recognizable, complete unbroken numbers. Due to long hair growth covering the brands at time of evaluation, neither freeze nor fire brands were legible so both sides of each cow were clipped prior to evaluation of the brands. The average brand score for the 200 Hereford cows was 4.1, with an overall standard deviation of 0.9. This average score indicates that most of the brands were easily recognizable but also suggests that several of the brands had some breaks or unbranded areas. The distribution of average brand scores by type of brand is shown in table 4, and the analysis of variance for brand score is presented in table 5. Type of brand was the only significant ($P<.01$), source of variation, and the least squares means presented in table 6 indicate the fire brands (4.35) were more legible than the freeze brands (3.75). The distribution of brand scores presented in table 4 shows that 168 (84%), of the fire brands were scored 4 or greater; whereas, only 106 (53%), of the freeze brands were scored 4 or greater. Table 4 also shows that 32 (16%), of the fire brands received a score of 3.5 or less which suggests that these brands were not very legible. In most cases, the numbers six and nine were responsible for the poor legibility of these fire brands. The same branding iron was used for both of these numbers, and if the iron was overheated at the time of application, some blotching of these two numbers usually occurred. At the time the brands were evaluated, the presence of white hair on the freeze brands was slight, although most of the freeze brands did have some white hair growth present around the periphery of each number. In fact, the legible freeze brands were similar in appearance to the legible fire brands, except the presence of scar tissue was not as evident on

the freeze brands as on the fire brands. No certain number tended to be responsible for the poor legibility of the freeze brands as was the case for the fire brands.

V. FUTURE PLANS:

Future plans are to continue according to the revised project outline.

VI. PUBLICATIONS DURING THE YEAR:

Thrift, F. A., J. D. Kemp, N. W. Bradley, and W. P. Garrigus. 1969. Effect of sire on certain carcass traits of young bulls. Kentucky Animal Science Research Report. Progress Report 181.

Thrift, F. A., D. D. Kratzer, N. W. Bradley, J. D. Kemp, and W. P. Garrigus. 1969. Effect of sire, sex, and sire x sex interactions on beef cattle performance and carcass traits. Kentucky Animal Science Research Report. Progress Report 181.

Thrift, F. A., D. D. Kratzer, J. D. Kemp, N. W. Bradley, and W. P. Garrigus. 1970. Effect of sire, sex, and sire x sex interactions on beef cattle performance and carcass traits. J. Animal Sci. 30:182.

VII. PUBLICATIONS PLANNED:

None.

Table 1. Comparison of growth data of selected bulls (SB) with all bulls (AB) (1969 calves)

		Preweaning		Postweaning			
	No.	Actual wean. wt.	Adj. 205-day[a] wt.	ADG	WDA	Final wt.	Adj. 365-day[a] wt.
Selected Bulls (SB)	6	509	456	2.31	2.22	898	826
All Bulls (AB)	59	414	391	1.95	1.86	742	701
Difference (SB-AB)		+95	+65	+0.36	+0.36	+156	+125

[a]Adjusted for age of dam.

Table 2. Analysis of variance for growth and blood traits

		Mean squares[a]			
		High vs. Low (1)		Residual (22)	
Trait		Bulls	Heifers	Bulls	Heifers
Growth traits:					
Actual wean wt.		41168**	39690**	2565	1552
205-day wt.		12240**	52828**	1827	826
Final wt.		181308**	94752**	4057	1728
Postweaning ADG		1.85**	0.45**	0.07	0.02
Wt./day/age		0.94**	0.66**	0.03	0.01
365-day wt.		115093**	112751**	3483	865
Blood traits:					
Urea nitrogen		98.01	0.03	110.21	1.93
Total protein		0.00	0.69	0.36	0.26
Glucose		121.50	36.26	198.29	167.86
Free amino nitrogen		9.38	48.74	10.76	27.43
Aspartic acid	M[b]	3.50	3.02	1.04	3.15
	%	1.33	0.53	0.73	1.15
Threonine	M	0.08	0.07	23.42	8.61
	%	1.62	0.36	1.84	1.58
Serine	M	0.22	11.04	18.74	11.65
	%	0.01	0.16	1.07	5.14
Glutamic acid	M	0.03	11.94	26.24	33.27
	%	0.17	0.02	4.43	6.85
Proline	M	43.41	11.99	35.28	23.85
	%	0.70	15.58	11.61	5.78
Glycine	M	55.63	40.09	151.53	49.43
	%	6.30	0.75	6.93	11.33
Alanine	M	0.45	20.13	44.44	46.35
	%	0.19	0.01	1.85	9.94
Valine	M	69.29	4.32	93.62	19.25
	%	11.06	8.11	7.47	2.37
Cystine	M	2.60	5.23	11.87	6.72
	%	0.04	2.11	0.74	1.94
Methionine	M	0.19	3.20	0.98	5.85
	%	0.31	0.11	1.00	1.36
Isoleucine	M	1.53	322.08	20.01	194.48
	%	0.04	63.57	1.28	56.43
Leucine	M	1.29	15.42	44.77	101.72
	%	0.01	3.63	1.96	30.56
Tyrosine	M	6.55	0.19	7.57	2.27
	%	2.06	0.00	1.61	1.06
Phenylalanine	M	1.17	0.54	6.48	2.61
	%	0.20	0.05	1.33	0.33
Lysine	M	0.79	13.23	13.11	10.89
	%	0.25	1.06	0.98	1.53
Histidine	M	0.02	27.14	8.91	32.85
	%	0.08	1.33	0.85	8.20
Arginine	M	6.15	0.38	30.64	14.28
	%	0.31	4.75	1.40	1.94
Total amino acids		122.27	2015.20	5045.04	1855.38

[a]Values in parentheses are degrees of freedom.
[b]M = Molar concentration; % = Percent of total amino acids.
**P<.01.

Table 3. Least squares means for growth and blood traits

		Least squares means			
		Bulls		Heifers	
		High	Low	High	Low
Growth traits:					
Actual wean. wt.		436**	354	396**	314
205-day wt.		437**	392	413**	319
Final wt.		872**	698	601**	475
Postweaning ADG		2.67**	2.11	1.26**	0.99
Wt./day/age		2.32**	1.92	1.62**	1.29
365-day wt.		864**	725	614**	477
Blood traits:					
Urea nitrogen		18.56	22.60	7.09	7.03
Total protein		8.44	8.43	7.54	7.20
Glucose		86.54	91.04	96.79	99.25
Free amino nitrogen		56.92	55.67	48.83	51.68
Aspartic acid	M[a]	1.69	2.45	1.76	2.47
	%	1.02	1.49	1.10	1.40
Threonine	M	7.21	7.10	6.84	6.95
	%	3.61	4.13	4.11	3.86
Serine	M	8.28	8.09	7.83	9.19
	%	4.45	4.42	5.31	5.15
Glutamic acid	M	15.77	15.85	14.36	15.77
	%	9.01	9.18	8.70	8.75
Proline	M	12.06	14.75	13.55	12.13
	%	8.53	8.19	8.40	6.79
Glycine	M	28.04	25.00	21.73	24.31
	%	15.23	14.21	13.37	13.73
Alanine	M	20.69	20.41	19.34	21.17
	%	11.35	11.53	11.83	11.80
Valine	M	22.01	18.61	13.53	12.68
	%	11.79	10.43	8.19	7.02
Cystine	M	5.70	5.04	4.01	3.08
	%	2.69	2.77	2.40	1.81
Methionine	M	0.81	0.63	0.66	1.39
	%	0.63	0.41	0.49	0.63
Isoleucine	M	8.66	8.16	11.19	18.52
	%	4.64	4.56	6.63	9.89
Leucine	M	14.26	13.79	13.46	15.06
	%	7.71	7.76	8.56	7.78
Tyrosine	M	4.26	5.31	3.73	3.91
	%	2.38	2.97	2.28	2.26
Phenylalanine	M	4.37	4.81	4.32	4.62
	%	2.50	2.68	2.61	2.52
Lysine	M	8.83	9.19	7.67	9.16
	%	4.98	5.18	4.55	4.97
Histidine	M	7.30	7.35	10.07	12.19
	%	4.07	4.18	6.14	6.61
Arginine	M	11.42	10.41	9.61	9.36
	%	6.15	5.93	5.92	5.03
Total amino acids		181.49	176.97	163.62	181.94

[a]M = Molar concentration; % = Percent of total amino acids.

**P <.01.

Table 4. Distribution of brand scores by type of brand

Type of brand	Average brand score[a,b] 1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	Total
Fire	0 (0.0)	0 (0.0)	2 (1.0)	3 (1.5)	8 (4.0)	19 (9.5)	33 (16.5)	66 (33.0)	69 (34.5)	200
Freeze	2 (1.0)	6 (3.0)	12 (6.0)	16 (8.0)	25 (12.5)	33 (16.5)	36 (18.0)	25 (12.5)	45 (22.5)	200
Total	2 (0.5)	6 (1.5)	14 (3.5)	19 (4.8)	33 (8.3)	52 (13.0)	69 (17.3)	91 (22.8)	114 (28.5)	400

[a]Average of two personnel doing scoring.
[b]Values in parentheses are percents.

Table 5. Analysis of variance for brand score

Source	d.f.	Mean squares
Total	399	
Age of cow	1	0.0115
Side of cow	1	0.5756
Type of brand	1	32.9441**
Age x Side	1	0.3893
Age x Brand	1	1.1987
Side x Brand	1	0.6332
Residual	393	0.7440

**P<.01.

Table 6. Least squares means for brand score

Effect	No.	Means
Overall mean	400	4.06
Age of cow		
<3 (Y)[a]	138	4.05
3+ (O)	262	4.06
Side of cow		
Right (R)	200	4.09
Left (L)	200	4.02
Type of brand		
Fire (H)	200	4.35
Freeze (C)	200	3.75
Age x Side		
Y x R	69	4.12
Y x L	69	3.98
O x R	131	4.07
O x L	131	4.05
Age x Brand		
Y x H	69	4.29
Y x C	69	3.81
O x H	131	4.42
O x C	131	3.70
Side x Brand		
R x H	100	4.36
R x C	100	3.83
L x H	100	4.36
L x C	100	3.67

[a]Refers to first-calf heifers and replacement heifers.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Kentucky

Location		Princeton	Princeton	Princeton		
Breed of sire		Hereford	Hereford	Hereford		
Breed of dam		Hereford	Hereford	Hereford		
Line or group[1]		Control(2)	Select(4)			
Percent used in project		100	100			
Inventory as of July 1, 1970	Cows 2 years and over	94	92			
	Yearling heifers	41	40			
	Bulls and steers under 1 year	44	35			
	Heifers under 1 year	43	40			
	Bulls over 1 year			20[a]		
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]	88	81			
	Calf survival percent[3]	88	82			
Wean perf.	Adj. ADG[4]			1.42[b]		
	Av. type sc.[5]			12[b]		
Postweaning performance	No. of bulls			59[b]		
	No. of heifers			81[b]		
	No. of steers					
Slaughtered	No. of bulls			49[b]		
	No. of heifers					
	No. of steers					
Remarks	[a]Foundation sires. [b]These bulls and heifers were not under the revised project.					

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: **Age of dam; sex of calf.**

5 - Suggest S-10 scoring system; indicate if different.

LOUISIANA STATE UNIVERSITY
Agricultural Experiment Station
Baton Rouge, Louisiana

I. PROJECT: Hatch 605 (Revised)

Evaluation of systematic rotational crossbreeding plans for producing beef cattle in the Gulf Coast region.

II. OBJECTIVES:

To evaluate systematic rotational crossbreeding plans as breeding systems for commercial beef production.

To determine the degree of heterotic advantage maintained in subsequent generations of rotational crossbreeding.

To determine the relative productivity of various types of crossbred cows.

To estimate genetic parameters.

To study specific crossbreeding programs of various breeds as to production, usefulness and practicality.

To study management and production problems associated with crossbred cattle produced under systematic crossbreeding schemes.

III. PERSONNEL:

J. W. Turner, George L. Robertson, A. M. Mullins, C. K. Vincent, T. O. McRae, S. E. McCraine and Dorothy C. Wilson

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Scope and nature of work.

The 1969 calf crop was produced without reference to design in order to incorporate purchased cows into the project and to maintain production in cows carried over to the revised project. All heifer calves were sold at weaning and steer calves were used to "dry run" the procedures for revision.

Additional emphasis has been directed toward use of temporary forages in the project and several management procedures have been altered.

Several repairs to existing facilities have been completed.

The 1970 calf crop, the first under the revision, is on the ground and data collection is proceeding as outlined.

2. Research results.

Final analysis of data on preweaning traits was completed on grade Charolais cattle by generation and foundation. Foundation and grade differences were found that indicated heterotic effects, both maternal and direct, were present. The foundation x generation or grade of Charolais breeding interaction was observed to be nonsignificant, indicating initial foundation differences were present among 15/16 calves.

Estimates of preweaning heterosis were determined from previous analyses of data from straightbred and singlecross calves of Angus, Brahman, Brangus and Hereford breeding.

These results were reported at Memphis, Tennessee, at the Southern Section Meetings.

V. FUTURE PLANS:

Data collection and operation under the revised project outline will be followed.

Additional complementary studies will be conducted on various cattle generated during Phase I of the revised outline.

VI. PUBLICATIONS DURING THE YEAR:

Turner, J. W. and R. P. McDonald. 1969. Mating-type comparisons among crossbred beef cattle for preweaning traits. J. Animal Sci. 29:389.

Turner, J. W. 1969. Preweaning production differences among reciprocal crossbred beef cows. J. Animal Sci. 29:857.

Mondart, C. L., Jr., R. P. McDonald, J. W. Turner, C. B. Singletary and C. R. Chaney. 1970. Beef production with annual forage species. La. Fertilizer Conference. Mimeo. Rpt. Plant Food Education Society.

Turner, J. W., P. E. Humes and R. P. McDonald. 1970. Foundation breed effects in grading-up Charolais. J. Animal Sci. 30:330. (Abstr.).

McDonald, R. P. and J. W. Turner. 1970. Preweaning heterosis in Louisiana beef calves. J. Animal Sci. 30:330. (Abstr.).

VII. PUBLICATIONS PLANNED:

Turner, J. W., John B. Mailhes and A. M. Mullins. 1970. Heterotic effects in postweaning and carcass traits of beef steers. J. Animal Sci. (manuscript submitted for review).

Turner, J. W. et al. Mating-type comparisons among crossbred beef steers for postweaning and carcass traits.

EXPLANATORY NOTES

for

PRODUCTION, INVENTORY AND PERFORMANCE DATA SHEETS

LINES

1	Straightbred Angus
2	Straightbred Brahman
3	Straightbred Charolais
4	Straightbred Hereford
5	Angus x Brahman Crisscross
6	Charolais x Brahman Crisscross
7	Hereford x Brahman Crisscross
8	Angus x Charolais x Brahman Three-Breed Rotation
9	Angus x Hereford x Brahman Three-Breed Rotation
10	Hereford x Charolais x Brahman Three-Breed Rotation
11	Four Breed Rotation

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Louisiana

Location		Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge
Breed of sire		Angus	Angus	Charolais	Hereford	Brahman
Breed of dam		Angus	A x B	A x B	A x B	Brahman
Line or group[1] *		1	5	8	11	2
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over	35	11	12	10	35
	Yearling heifers	0	0	0	0	0
	Bulls and steers under 1 year	11	4	4	6	5
	Heifers under 1 year	14	7	4	3	9
	Bulls over 1 year	11	0	0	0	3
	Steers over 1 year	1	2	0	0	0
Repro. perf.	Percent pregnant[2,6]	77	92	92	91	63
	Calf survival percent[3]					
Wean perf.	Adj. ADG[4]	No data given on 1969 calves. All 1969 calves sold due to project revision.				
	Av. type sc.[5]					
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers[7]	7	0	0	0	9
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers	7	0	0	0	9
Remarks	*See explanatory notes following forms.					

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.
6 - 1970 calf crop
7 - 1968 steers

S-10-1 (Rev.)
4-70

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Louisiana

		Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge
Location		Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge
Breed of sire		Angus	Charolais	Hereford	Angus	Charolais
Breed of dam		B x A	B x A	B x A	B x H	B x H
Line or group[1]		5	8	11	9	10
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over	16	15	16	16	15
	Yearling heifers	0	0	0	0	0
	Bulls and steers under 1 year	7	6	12	8	7
	Heifers under 1 year	6	5	3	7	7
	Bulls over 1 year	0	0	0	0	0
	Steers over 1 year	7	3	2	7	1
Repro. perf.	Percent pregnant[2,6]	81	80	94	94	88
	Calf survival percent[3]					
Wean perf.	Adj. ADG[4]	No data given on 1969 calves. All 1969 calves sold due to project revision.				
	Av. type sc.[5]					
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers[7]	0	0	1	1	1
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers	0	0	1	1	0
Remarks	*See explanatory notes following forms.					

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.
6 - 1970 calf crop
7 - 1968 steers

S-10-1 (Rev.)
4-70

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Louisiana

Location		Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge
Breed of sire		Hereford	Charolais	Charolais	Hereford	Angus
Breed of dam		B x H	Charolais	C x B	Hereford	H x B
Line or group[1]		7	3	6	4	9
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over	16	35	30	30	15
	Yearling heifers	0	0	0	0	0
	Bulls and steers under 1 year	8	12	12	9	7
	Heifers under 1 year	8	8	12	7	8
	Bulls over 1 year	0	8	0	6	0
	Steers over 1 year	4	3	13	0	0
Repro. perf.	Percent pregnant[2,6]	100	68	89	59	100
	Calf survival percent[3]					
Wean perf.	Adj. ADG[4]	No data given on 1969 calves. All 1969 calves sold due to project revision.				
	Av. type sc.[5]					
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers [7]	1	19	3	4	2
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers	1	19	3	4	2
Remarks	*See explanatory notes following forms.					

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.
6 - 1970 calf crop
7 - 1968 steers

S-10-1 (Rev.)
4-70

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Louisiana

Location		Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge	Baton Rouge
Breed of sire		Charolais	Hereford	Misc.		
Breed of dam		H x B	H x B	Misc. X's		TOTALS
Line or group[1] *		10	7			
Percent used in project		100	100	100		100
Inventory as of July 1, 1970	Cows 2 years and over	15	14	0		336
	Yearling heifers	0	0	0		0
	Bulls and steers under 1 year	5	5	0		128
	Heifers under 1 year	8	7	0		123
	Bulls over 1 year	0	0	0		28
	Steers over 1 year	1	6	9		59
Repro. perf.	Percent pregnant[2,6]	87	80	-		81
	Calf survival percent[3]					
Wean perf.	Adj. ADG[4]	No data given on 1969 calves. All 1969 calves sold due to project revision.				
	Av. type sc.[5]					
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers[7]	2	0	60		110
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers	2	0	54		103
Remarks	*See explanatory notes following forms.					

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.
6 - 1970 calf crop
7 - 1968 steers

IBERIA LIVESTOCK EXPERIMENT STATION
Jeanerette, Louisiana

I. PROJECT: 03-30-002-1906 (Revision No. 2)

Selection for changes in fat in beef cattle and the response of selection for adaptability of beef cattle in the Gulf Coast area.

II. OBJECTIVES:

To determine if changes in fat thickness of Angus and Brangus cattle can be made by selection in opposite directions for fatness-high fat and low fat.

To estimate genetic and environmental relationships of fatness and leanness with other performance and carcass traits.

To determine whether adaptation and increased production of Angus cattle in the Gulf Coast area can be made by selection of the best available sires from within the herd or by selection of the best available bulls from outside the area.

III. PERSONNEL:

T. M. DeRouen, W. L. Reynolds, H. C. Gonsoulin, B. F. Hollon, A. M. Mullins, J. W. Turner, W. T. Butts, Jr., and P. A. Putnam

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Scope of work.

Data were collected on several aspects of the studies. A total of 324 cows were bred in 1969. They were sorted into twenty-two single sire herds. Calves were born in February, March and April. In late July, calves were weaned when each one reached 180$\pm$ 7 days. Calves were weaned in groups every two weeks thereafter.

Bull calves were left entire, measured for fat thickness with an ultrasonic instrument at weaning, and went directly into dry lot for a gain-evaluation test. Sixty-five percent of the bulls were slaughtered for carcass evaluation at the end of the feed test. Other measurements were obtained during the year and will be reported.

Heifer calves, at weaning, were measured for fat and went back to pasture and were supplemented with a small amount of concentrate feed.

2. Research results.

<u>Breeding season and conception</u>. The breeding season began on May 1 and ended on July 15. Two of the breeding herds in the adaptability study were artificially mated.

There were eight breeding herds each for the Brangus and Angus fat study. Four breeding herds in each breed were designated as high fat and four as low fat.

The Brangus cattle in the fat study were developed on the station. The Angus cattle in the fat study were purchased high grades. The Angus in the adaptability study were the registered cattle already on the station plus several purebred heifers purchased in Louisiana.

Angus females in the adaptability study were sorted into six single sire herds. Four of these herds were bred naturally to bulls raised and grown on the station and designated as the "closed" line. Two other herds were bred artificially to bulls raised outside the Gulf Coast area and referred to as the "open" or "outside" line. All cows exposed to bulls during the breeding season were palpated in late October. A summary of the conception rate is presented in table 1.

Conception rate was below average in 1969. This was especially true for the Brangus. In the Brangus low fat herd, one bull failed to settle any cows while another bull in the same line got only nineteen percent of his cows pregnant. This is the first time that such low fertility has occurred in the low fat line. However, it should be pointed out that Brangus cattle at the station have not shown as high fertility as the Angus cattle. It appears at this time that the high fat cattle in both breeds have a higher conception rate than the low fat line.

The low fertility in the artificial insemination herds is difficult to explain. A sterile bull runs with these herds and pigmented grease is applied to his brisket daily. Cows are checked three or more times a day for heat.

All yearling replacement heifers that weighed over six hundred pounds were placed in the breeding herds in 1969. Five Brangus fat heifers had a 40 percent conception rate while six Angus fat heifers had a conception rate of 83 percent. The one Angus heifer in the adaptability study did not conceive.

Calving. Calf mortality during the first 72 hours after parturition was less than average for the station in 1969. Calf losses in the Angus were higher than usual. Calf losses after 72 hours are not unusual for the Brangus. These calves appear well and strong one day and then are found dead the next day. It was discovered that one Brangus calf had died because of a large ulcerated hole (not common) in the large intestine. Two other Brangus calves died of acute respiratory infection. An Angus calf was killed by a car on the highway. A summary of calving is presented in table 2.

Cow production - 1969 Calf Crop. Cow production is summarized in table 3. As can be noted, there is little difference between lines within a breed in the fat study. There are larger differences in performance of the cows in the adaptability project (table 3).

Growth of replacement heifers. All of these heifers were bred and raised on the station. Five pounds of a concentrate mixture was fed on pasture to the 1968 replacement heifers during winter. They also received molasses free choice.

A summary of the performance of the 1968 replacement heifers is presented in table 4. The average age of these heifers is twenty-four months. These heifers gained well since weaning. The low fat heifers in both breeds are heavier and growing at a faster rate than contemporaries in the high fat line. In the adaptability study the outside line heifers are twenty pounds heavier and gaining a little more rapidly than the local heifers.

Table 5 summarizes the performance of the 1968 replacement heifers at eighteen months of age. The Angus and Brangus in the fat study are showing trends of separating into low and high fat lines. The fat study is now five years old. The low fat heifers in both breeds are heavier than contemporaries in the high fat. Heifers in the adaptability study have identical weights and are similar in other traits.

A summary of the performance of the 1969 heifers is presented in table 6. The mean age of the heifers is approximately twelve months. The low fat Brangus heifers are lighter and are gaining slightly less than similar heifers in the high fat line. Angus heifers in both lines of the fat study are growing about the same daily rate. The adaptability Angus heifers are gaining at similar rates and weigh about the same.

Postweaning performance of bulls - 1969. After weaning, bull calves are placed in dry lot and full-fed in groups. Each bull in the fat study is fed to a constant weight of 800 pounds. At this weight, fat thickness is estimated over the 12th and 13th ribs with an ultrasonic instrument. Each bull calf in the adaptability study is fed to a constant age of 365 days. Growth rate and conformation are evaluated and an index is computed giving equal emphasis to these two traits.

Sixty-five percent of the bull progeny were slaughtered for carcass evaluation. Samples of calves from each sire in the studies are evaluated for carcass merit and quality.

Table 7 summarizes the postweaning performance of the bulls. There was a tendency in 1969 for the high fat bulls to have a slightly higher conformation score. In the past, the low fat bulls in each breed had tended to gain faster than the high fat bulls.

Bulls in the outside line of the Angus adaptability investigation have outgained contemporaries in the closed line. All other traits were similar (table 7). This is the first time that the outside sired bulls gained faster than the local sired bulls. Much less difficulty was observed in getting the outside bulls on feed, and there was much less bloat and digestive disturbances in the outside sired calves in 1969.

Slaughter data of bulls - 1969. Table 8 summarizes the slaughter and carcass information on the bulls in the various studies.

Brangus (Fat): The high fat bulls had heavier carcasses and greater carcass weight per day of age than contemporaries in the low fat line. It was noted that the low fat bulls had a larger ribeye area per hundred pounds of carcass than the high fat bulls.

Angus (Fat): The low fat bulls had heavier carcasses and slightly greater carcass weight per day of age than similar bulls in the high fat group.

Angus (Adaptability): In 1969 the bulls from the outside sires had a slightly higher carcass weight per day of age. The closed line bulls had more lean as measured by the ribeye area per hundred pounds of carcass. Other traits between the lines were quite similar.

Disease.

Anaplasmosis: Only two cases of anaplasmosis were observed in 1969. This occurred in two Brangus cows that had been vaccinated for the disease. The cows were treated and recovered with little apparent setback.

The station is continuing a program of test and treat for anaplasmosis. This is done in cooperation with the Louisiana State Livestock Department and the USDA, ARS Animal Health Division.

Parainfluenza: No respiratory troubles were noted in the cattle on feed. These cattle had been inoculated against this disease after they were on feed.

Urinary calculi: In the past, each year ammonium chloride has been added to the ration of all the bulls on the gain-evaluation feed test and none have suffered from calculi.

Parasites: All cattle were treated periodically for internal parasites. In the last several years the young cattle slaughtered at packing plants were inspected by the plant veterinarians. No liver fluke damage or other organ injury has been observed in the station cattle slaughtered.

In the spring, back rubbers are treated and installed in all pastures to control external parasites.

Johnes: Two Angus females were culled and sold because of their thin, unthrifty condition. They were also showing symptoms of Johnes disease. The station personnel have had some experience with this disease.

V. IMPROVEMENT OF FACILITIES:

1. A sales arena was constructed in the cattle feeding barn for the station to hold its annual sale of surplus bulls.

2. Installed new wire on existing fence at the headquarters area (C-1 pasture).

VI. FUTURE PLANS:

1. To follow plan of project.

2. Improvement of facilities:

Complete construction of fencing lane from annex pastures to working pens.

Repair working pens at annex.

Build roof over chute at annex to permit its use during rain and inclement weather. This is requested so that fat readings may be taken during bad weather.

Build two small holding pens with loading chutes at locations at annex to prevent having to drive cattle across a busy highway and two railroads and also to keep from having to drive injured or sick cattle long distances (1 1/4 miles).

Repair bridges at annex.

VII. PUBLICATIONS DURING THE YEAR:

DeRouen, T. M., W. L. Reynolds, H. C. Gonsoulin, D. C. Meyerhoeffer, and N. T. Poche. 1969. Beef Cattle Research at the Iberia Livestock Experiment Station. Ninth Livestock Producers' Day Report, Department of Animal Science, Louisiana State University and Agriculture Experiment Station, Baton Rouge.

Reynolds, W. L., T. W. White, T. M. DeRouen and D. C. Meyerhoeffer. 1969. Distribution of slow gaining steers in subsequent periods. J. Animal Sci. 29:152. (Abstr.).

Reynolds, W. L., T. W. White, T. M. DeRouen and D. C. Meyerhoeffer. 1969. Effect of nutritional level on repeatability of steer gain. J. Animal Sci. 27:135. (Abstr.).

VIII. PUBLICATIONS PLANNED:

Review of old project.

Table 1. Palpation for 1969

Breed	Line	No. Cows Exposed	Percent Pregnant
Brangus	Hi fat	63	76
Brangus	Lo fat	59	53
Angus	Hi fat	55	89
Angus	Lo fat	63	84
Angus	Adapt. Closed	52	79
Angus	Adapt. Outside (a)	30	50
Totals & Average		322	73

(a) Artificially inseminated.

Table 2. Calving Summary for 1969

	Losses 1st 72 hours				Losses after 72 hours				Totals		
			Dead				Dead				
Breed	Males	Females	No.	%	Males	Females	No.	%	No. Born	No. Dead	% Dead
Brangus	1	1	2	3	3	2	5	6	77	7	9
Angus-fat	1	2	3	5	0	0	0	0	58	3	5
Angus-adapt.	0	2	2	4	1	0	1	2	56	3	5
Total:	2	5	7	4	4	2	6	3	191	13	7

Table 3. Cow Production. - 1969.

Breed Group Line	Brangus Fat Hi	Brangus Fat Lo	Angus Fat Hi	Angus Fat Lo	Angus Adapt. Local	Angus Adapt. Outside (a)
No. cows exposed	63	59	55	63	52	30
No. calves born (b)	46	31	26	32	36	20
Avg. birth wt. - lbs.	62	68	57	58	60	57
No. calves weaned	41	29	23	31	33	19
% calves weaned	89	94	88	97	92	95
Avg. wean. age - days	181	181	179	179	179	180
Actual wean. wt. - lbs.	375	374	281	292	279	259
Adjusted wean. adg. - lbs. (c)	1.86	1.82	1.37	1.41	1.34	1.25
Avg. type score (d)	10.6	10.2	10.8	10.1	11.3	10.5
Avg. condition score (d)	9.5	9.4	8.8	8.3	9.0	8.5
Fat thickness (mm)	4.34	3.98	4.00	3.48	--	--
Index (e)	118	114	100	98	102	96

(a) Artificially inseminated.
(b) Includes dead and live calves.
(c) Adjusted for sex of calf and age of dam.
(d) Choice = 12, 13, 14. Good = 9, 10, 11.
(e) Equal emphasis to growth and to conformation.

Table 4. Performance of Replacement Heifers Born in 1968.

Breed Group Line	Brangus Fat Hi	Brangus Fat Lo	Angus Fat Hi	Angus Fat Lo	Angus Adapt. Closed	Angus Adapt. Outside
Number	12	13	5	10	10	7
Avg. Wt. (lbs)	774	816	675	747	681	701
Avg. Age (days)	722	713	737	724	733	717
Wt/Day of Age (lbs)	1.07	1.14	0.92	1.03	0.93	0.98

Table 5. Performance of Replacement Heifers Born in 1968.

Breed Group Line	Brangus Fat Hi	Brangus Fat Lo	Angus Fat Hi	Angus Fat Lo	Angus Adapt. Closed	Angus Adapt. Outside
Number	14	16	9	13	13	7
Avg. Wt. (lbs)	673	696	604	626	550	550
Avg. Age (days)	549	537	561	552	556	541
Wt/Day of Age (lbs)	1.23	1.30	1.08	1.13	0.99	1.02
Fat (mm)	4.8	4.1	4.1	3.9	--	--
Type Score*	9.9	10.2	10.5	10.8	10.4	10.8
Condition Score*	7.5	7.1	7.7	7.9	7.4	7.8

* Score: 6, 7, 8 = standard; 9, 10, 11 = good.

Table 6. Performance of Replacement Heifers Born in 1969.

Breed Group Line	Brangus Fat Hi	Brangus Fat Lo	Angus Fat Hi	Angus Fat Lo	Angus Adapt. Closed	Angus Adapt. Outside
Number	23	18	10	15	14	8
Avg. Wt. (lbs)	503	472	454	466	441	439
Avg. Age (days)	359	349	368	372	355	362
Wt/Day of Age (lbs)	1.40	1.35	1.23	1.25	1.24	1.21

Table 7. Postweaning Performance of Bulls Fed in 1968 - 1969.

Breed Study Line	Brangus Fat Hi	Brangus Fat Lo	Angus Fat Hi	Angus Fat Lo	Angus Adapt. Closed	Angus Adapt. Outside
Number fed	15	18	10	15	16	10
Avg. initial wt. (lbs)	393	398	316	312	289	262
Number days fed	157	184	204	198	186	187
Avg. final wt. (lbs)	800(a)	800(a)	800(a)	800(a)	724(b)	741(b)
Adg. on test (lbs)	2.59	2.24	2.37	2.47	2.34	2.56
Avg. age end test (days)	338	363	384	377	366	366
Avg. type score (c)	10.3	9.4	11.6	11.4	12.3	12.4
Avg. condition score (c)	9.7	9.1	11.1	11.2	11.9	11.8
Fat thickness (mm) (d)	8.6	7.6	8.7	7.9	--	--
Fat thickness (inches) (d)	0.34	0.30	0.34	0.31	--	--
% Zebu	37.63	39.66	--	--	--	--
% Inbreeding	4.27	3.81	--	--	--	--
Index	--	--	--	--	106	102

(a) Each bull fed to a constant weight of 800 pounds.
(b) Each bull weighed at a constant age of 365 days.
(c) Choice = 12,13, 14; Good = 9, 10, 11.
(d) Measured when each bull weighed 800 pounds.

Table 8. Slaughter Data of Bulls 1968 - 1969

Breed Study Line	Brangus Fat Hi	Brangus Fat Lo	Angus Fat Hi	Angus Fat Lo	Angus Adapt. Closed	Angus Adapt. Outside
Number slaughtered	7	13	13	16	9	6
Final weight (lbs)	895	826	766	796	698	758
Slaughter age (days)	406	408	410	412	403	402
Days fed	226	228	228	232	222	221
Avg. daily gain (lbs)	2.27	1.96	2.06	2.12	1.98	2.36
Slaughter weight (lbs)	866	800	742	776	681	725
Slaughter scores:						
Type	10.2	9.5	11.1	11.7	12.0	12.3
Condition	9.3	8.7	10.7	11.2	11.6	11.7
Carcass weight - warm (lbs)	542	490	459	483	428	452
Dressing percent - warm	62.49	61.28	61.79	62.15	62.84	62.25
Carcass grades: (a)						
Conformation	10.3	9.8	11.0	11.8	12.1	12.2
Composite	8.8	8.1	9.5	10.0	10.1	9.7
Quality	8.8	8.1	9.6	10.1	10.1	9.7
Yield	1.5	1.3	1.7	1.6	1.5	1.6
Marbling (a)	7.4	6.7	7.5	8.3	7.8	8.0
Kidney fat % (a)	1.10	0.90	1.23	1.28	0.94	1.10
Ribeye area sq. ins.	11.98	11.62	10.98	10.99	11.19	11.02
Ribeye area/100 lbs. carcass	2.26	2.46	2.48	2.35	2.70	2.52
Shear 1" core	25.90	26.25	21.60	22.34	24.32	24.25
Fat thickness - mm (b)	10.5	7.0	13.4	11.5	13.2	11.7
Fat thickness - inches (b)	0.41	0.28	0.53	0.45	0.51	0.46
Carcass wt/day of age (lbs)	1.33	1.20	1.11	1.16	1.06	1.12

(a) Estimated by federal grader.
(b) Measured from ribeye tracings at 3 places and averaged.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Louisiana

Location		Jeanerette	Jeanerette	Jeanerette	Jeanerette	--
Breed of sire		Brangus	Brangus	Angus	Angus	
Breed of dam		Brangus	Brangus	Angus	Angus	
Line or group[1]		Hi Fat	Lo Fat	Hi Fat	Lo Fat	
Percent used in project		100	100	100	100	
Inventory as of July 1, 1970	Cows 2 years and over	57	62	58	62	
	Yearling heifers	23	17	10	15	
	Bulls ~~XXXXXXXXXX~~ under 1 year	23	17	24	27	
	Heifers under 1 year	18	11	19	22	
	Bulls over 1 year	9	8	9	9	
	Steers over 1 year	0	0	0	0	
Repro. perf.	Percent pregnant[2]	76	53	89	84	
	Calf survival percent[3]	89	94	88	97	
Wean perf.	Adj. ADG[4] lbs.	1.86	1.82	1.37	1.41	
	Av. type sc.[5]	10.6	10.2	10.8	10.1	
Postweaning performance	No. of bulls	15	18	10	15	
	No. of heifers	19	15	10	15	
	No. of steers	0	0	0	0	
Slaughtered	No. of bulls	7	13	13	16	
	No. of heifers	0	0	0	0	
	No. of steers	0	0	0	0	
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: Sex of calf and age of dam.

5 - Suggest S-10 scoring system; indicate if different.

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Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Louisiana

Location		Jeanerette	Jeanerette			
Breed of sire		Angus	Angus			
Breed of dam		Angus	Angus			
Line or group[1]		Close	Outside			
Percent used in project		100	100			
Inventory as of July 1, 1970	Cows 2 years and over	52	32			
	Yearling heifers	13	8			
	Bulls ~~XXXXXXXXXX~~ under 1 year	18	8			
	Heifers under 1 year	22	7			
	Bulls over 1 year	9	0			
	Steers over 1 year	0	0			
Repro. perf.	Percent pregnant[2]	79	50			
	Calf survival percent[3]	92	95			
Wean perf.	Adj. ADG[4] lbs.	1.34	1.25			
	Av. type sc.[5]	11.3	10.5			
Postweaning performance	No. of bulls	16	10			
	No. of heifers	13	8			
	No. of steers	0	0			
Slaughtered	No. of bulls	9	6			
	No. of heifers	0	0			
	No. of steers	0	0			
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: **Sex of calf and age of dam.**

5 - Suggest S-10 scoring system; indicate if different.

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MISSISSIPPI STATE UNIVERSITY
Agricultural Experiment Station

I. PROJECT: Hatch 3-207-666

A study to determine the breeding worth of inbred and outbred bulls from various sources.

II. OBJECTIVES:

To compare pre- and postweaning growth rates, market grades, carcass qualities, and maternal ability of the progenies of potentially superior sires selected from various sources.

III. PERSONNEL:

Fay Hagan and L. J. Smithson

IV. ACCOMPLISHMENTS DURING THE YEAR:

Calves sired by bulls from the four inbred lines (lines 1-4) and two single-trait selection lines (lines 7 and 8) of Angus were produced again in 1969. Postweaning and carcass data were obtained on steers born in 1968 from each line. In addition, the first heifers sired by bulls from the six lines were mated to bulls from lines other than the heifers' sire line. The average preweaning performance summary is presented in the following table.

Preweaning Performance of 1969 Calf Crop

Sire line	Birth wt.[a]	Av. daily gain[a]	Weaning grade	210 day wt.[a]	% cows calving	% cows wean. calves	No. of calves
1	58.3	1.62	11.8	402	74	70	16
2	56.4	1.63	11.5	403	65	57	13
3	65.1	1.58	10.9	398	63	58	14
4	56.3	1.54	10.8	386	96	96	22
7(type)	61.5	1.64	11.7	407	88	88	21
8(growth)	56.1	1.59	11.4	391	73	68	12

[a]Heifer calves adjusted to steer basis.

Data to slaughter on steers born in 1969 are presented in the following table. These steers were slaughtered June 24, 1970. They were on postweaning test for a total of 201 days, 92 days on a wintering ration and 109 days on a finishing ration.

Postweaning Performance of 1969 Steers

Sire line	No. of steers	Wt. on winter ration	A.D.G. winter ration	Wt. on finishing ration	A.D.G. finishing	Wt. at slaughter	Lb. feed per lb. of gain
1	4	434	1.32	554	1.98	768	11.72
2	5	451	1.68	605	2.69	899	9.65
3	5	448	1.50	586	2.40	848	10.52
4	5	407	1.65	560	2.48	831	11.19
7	5	480	1.48	616	2.68	909	10.47
8	5	450	1.53	591	2.58	872	11.68

The three year averages for preweaning performance in the six lines are given in the following table.

Average Preweaning Performance for 3 Years

Sire line	Birth[a] weight	210 day[a] weight	A.D.G.[a]	Weaning grade
1	61.1	407	1.64	11.5
2	60.1	410	1.66	11.3
3	65.0	392	1.60	11.0
4	61.4	400	1.61	11.0
7	63.2	414	1.67	11.3
8	60.7	412	1.67	11.6

[a]Heifer calves adjusted to steer basis.

V. FUTURE PLANS:

Continued cooperation with the Virginia Station.

VI. PUBLICATIONS DURING THE YEAR:

Hagan, Fay, C. B. Shawver, C. E. Lindley and H. H. Callahan. 1969. Top and rotational crossing of Angus beef bulls from inbred and single-trait selection lines. Livestock Day Report, ASC Series 1-8.

VII. PUBLICATIONS PLANNED:

None.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Mississippi

Location		Prairie				
Breed of sire		Angus				
Breed of dam		Angus				
Line or group[1]						
Percent used in project		100				
Inventory as of July 1, 1970	Cows 2 years and over	169				
	Yearling heifers	64				
	Bulls and steers under 1 year	70				
	Heifers under 1 year	68				
	Bulls over 1 year	13				
	Steers over 1 year	34				
Repro. perf.	Percent pregnant[2,6]	76.9				
	Calf survival percent[3]	92.2				
Wean perf.	Adj. ADG[4]					
	Av. type sc.[5]					
Postweaning performance	No. of bulls	0				
	No. of heifers	68				
	No. of steers	34				
Slaughtered	No. of bulls	0				
	No. of heifers	0				
	No. of steers	34				
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.
6 - 1969 calf crop

NORTH CAROLINA STATE UNIVERSITY
Agricultural Experiment Station
Raleigh, North Carolina

I. PROJECT: Animal Science 1010

Direct and correlated response to selection for weaning weight and postweaning gain.

II. OBJECTIVES:

To measure the effectiveness of selection to increase 205-day weight and post-weaning gain to 365 days and to evaluate correlated response in other traits

To investigate phenotypic and genetic relationships between growth and milk production.

III. PERSONNEL:

E. U. Dillard, O. W. Robison, W. T. Ahlschwede, J. E. Legates, J. J. Rutledge, T. N. Blumer, and J. A. Vesely

IV. ACCOMPLISHMENTS DURING THE YEAR:

Seventy 1969 bull calves, 47 at Plymouth and 23 at Raleigh, completed the post-weaning gain test and selections were made for bulls to be used in the 1971 season. Both 205-day weights and gain from 205 to 365 days were less than for 1968 calves at both locations.

Semen was collected and processed from the 1968 bulls beginning when the oldest were just at two years of age. Some difficulty was still experienced in obtaining quality semen but, in general, ejaculates were of about normal volume for this age beef bull.

Reproductive performance of cows bred to the first group of selected young bulls (1967 calves) was lower than in previous years when semen from mature bulls was used. One of the nine selected bulls had to be replaced by his alternate because of near zero fertility.

Environmental factors affecting milk production and weaning weight were investigated in data collected during 1968 and 1969 on 279 Hereford cow-calf pairs. Milk yield was estimated monthly for the first seven months by the calf-suckling technique.

Effects of years, sexes and sires contributed significantly to the variance of 205-day weight. Linear regressions on the first four monthly milk measures were significant and positive, whereas those on subsequent monthly milk measures were non-significant. A cubic response of weaning weight to weight of dam was found; although the regression line was positive and essentially linear over the sample space. Response of weaning weight to birth weight was linear and positive. The reduced model which included effects due to years, herds, sires, sexes and the regressions on the first four monthly milk yields, birthdate and weight of calf, and cow weight accounted for 92 percent of the variation in calf weaning weight.

The analysis of variance of milk production (total of seven monthly estimates), revealed significant effects of years and sex of calf. Linear regressions on calf birthweight and cow weight were significant and positive. Milk yield had a quadratic response with cow age, with a maximum at 8.4 years. The reduced model accounted for 68 percent of the variance in milk production.

Ratio and regression equation estimates of total milk production, based upon sampling three times during the lactation, did equally well as judged from the correlation between predicted and actual milk production. Milk yield is reasonably well estimated by measurements taken in months 1, 3, and 5, or months 2, 4, and 6; thus it is possible to get estimates on most cows by using the calf suckling technique three times corresponding roughly to the second, fourth, and sixth months from the beginning of the calving season when using a 90-day or shorter breeding season.

Milk composition did not appear to have an appreciable effect on weaning weights.

Conventional and empirical selection indexes were computed from data collected on beef cattle of four herds that have been involved in the present study and in the genotype by environment interaction project. These data represented records of 1962 progeny of 29 sires in the years 1952-1968. Traits considered in the selection indexes were: birth weight, weaning weight, and type score at weaning.

Heritabilities obtained from paternal half-sib correlations were 0.67, 0.50, and 0.36 for birth weight, weaning weight, and type score, respectively. When causal components for maternal effects were applied for adjusting these estimates the new values of the estimates were 0.49, 0.36, and 0.17.

The descending order of the conventional indexes, with respect to the correlation between the index and genetic worth, was: the full model utilizing all three traits, indexes based on weaning weight and type score, birth and weaning weights, weaning weight alone, birth weight and type score, and type score alone. The correlation coefficients in the respective order were: 0.71, 0.70, 0.68, 0.66, 0.18, and 0.16.

Using the adjusted heritability estimates, the order of the index efficiencies remained the same, but their correlation coefficients with genetic worth were reduced by 15-20 percent except for those for birth weight and type score and type score alone which were reduced by 34 and 44 percent, respectively.

Equations for predicting economic values of calves utilizing information on 11 characteristics of heifers and 14 characteristics of mature cows were determined. These full models were compared to models of various reduced combinations of the independent variables. Three empirical indexes for heifers and three for cows were compared with the conventional indexes. The correlation coefficient of the most efficient index with genetic worth was 0.47 for heifers and 0.41 for mature cows.

A new device for measuring tenderness on the hanging carcass, Armour's Tenderometer, was employed for the first time this year on all carcasses. The results will be compared with other techniques such as the Warner-Bratzler shear and taste panel evaluations.

V. FUTURE PLANS:

The selection study will be prosecuted according to plan.

VI. PUBLICATIONS:

Vesely, John Anthony. 1970. Conventional and empirical selection indexes for beef cattle. Ph.D. Dissertation. North Carolina State University.

Rutledge, Jackie Joe. 1970. Estimation of milk production of beef cows and the influence of milk production on 205-day weight of beef calves. M.S. Thesis. North Carolina State University.

VII. PUBLICATIONS PLANNED:

Publications are planned from the material in the theses listed above and from previous work on genotype by environment interactions.

VIII. COOPERATING AGENCIES:

North Carolina Department of Agriculture

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State North Carolina

		Raleigh	Plymouth			
Location		Raleigh	Plymouth			
Breed of sire		Hereford	Hereford			
Breed of dam		Hereford	Hereford			
Line or group[1]						
Percent used in project		100	100			
Inventory as of July 1, 1970	Cows 2 years and over	98	111			
	Yearling heifers	32	44			
	Bulls and steers under 1 year	25	51			
	Heifers under 1 year	34	34			
	Bulls over 1 year	6	12			
	Steers over 1 year	0	0			
Repro. perf.	Percent pregnant[2] (1968 breeding)	62	82			
	Calf survival percent[3] (1969 calves)	78	91.2			
Wean perf.	Adj. ADG[4]	1.55	1.59			
	Av. type sc.[5]	9.5	9.8			
Postweaning performance	No. of bulls	23	47			
	No. of heifers					
	No. of steers	0	0			
Slaughtered	No. of bulls	15	35			
	No. of heifers	0	0			
	No. of steers	0	0			
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: Adj. for sex and age of dam

5 - Suggest S-10 scoring system; indicate if different.

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CLEMSON UNIVERSITY
Agricultural Experiment Station
Clemson, South Carolina

I. PROJECT: SC-479 (S-10)

The response of sire progenies to management and feeding procedures.

II. OBJECTIVES:

To investigate the response of sire progenies, as measured by live animal and carcass traits to methods of producing slaughter cattle.

To evaluate the magnitude and importance of the average genotype with certain environmental influences.

To develop, through selection, herds of beef cattle with superior performance under South Carolina conditions.

III. PERSONNEL:

W. C. Godley, J. R. Hill, Jr., G. C. Skelley, Jr., R. M. Rauton, and R. F. Wheeler

IV. ACCOMPLISHMENTS DURING THE YEAR:

One hundred and twenty-five purebred Angus and 66 purebred Polled Hereford cows were put in the breeding herds to produce the 1969 calf crop. Five Angus and three Polled Hereford bulls were used during the breeding season. Twelve and one-half percent of the cows were open as determined by a pregnancy check. Calf mortality including those born dead was approximately 12.0 percent. Some difficulty believed to be due to a magnesium deficiency was experienced during the late winter and early spring. This is reflected in the poor performance, especially in the Polled Hereford herd. Thirteen bulls (nine Angus and four Hereford bull calves), were fed on pasture on 140-day ROP feeding trial. Feeding and carcass data from 37 steer calves were obtained.

The reproductive performance of females in the Clemson University beef cattle herds was studied in 1968 and 1969. The cows and heifers were mated during a 75-day breeding period (April 1-June 15) each year. The average pregnancy rate was 85 percent (based on 1020 possible pregnancies). The lowest pregnancy rate (73%) was in cows (27-30 months old), nursing their first calf during the breeding period and highest in cows that were nursing their second or later calf.

In September of each year, the non-pregnant females were culled from the herds and were assembled in a group and mated on the first observed estrus to two bulls. Three to six days after mating these females were slaughtered, ova were recovered, and their genital tracts were examined for abnormalities. Seventy-three ova were recovered from 107 cows (68%). Fifty-eight (79%) of the ova were cleaved. Eleven percent of the cows that were open at the end of the regular breeding season had gross genital abnormalities that were not obstructive to conception.

Three methods for estimating milk production of beef cows were compared. The methods were: (1) 24-hour calf-suckle (milk yield estimated by weighing calves before and after nursing); (2) 6-hour oxytocin; and (3) calf-suckle plus osytocin (residual). All three methods gave similar rankings of the cows for milk production. Since the ranks were not greatly different from one method to another, the method that is most practical for a given situation should be used.

V. FUTURE PLANS:

A new project is being planned and will include only the Angus cattle.

VI. PUBLICATIONS DURING THE YEAR:

Godley, W. C., D. E. Ramage, and J. R. Hill, Jr. 1970. The influence of cow size and condition on calf performance. J. Animal Sci. 30:320. (Abstr.).

Lam, C. F., D. R. Lammond, J. R. Hill, Jr., and C. B. Loadholt. 1970. Three methods for estimating milk production of beef cows. South Carolina Experiment Station Tech. Bul. 1036.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State South Carolina

Location		Clemson	Clemson			
Breed of sire		Angus	Hereford			
Breed of dam		Angus	Hereford			
Line or group[1]		Purebred	Purebred			
Percent used in project		100	100			
Inventory as of July 1, 1970	Cows 2 years and over	117	33			
	Yearling heifers	39	12			
	Bulls and steers under 1 year	68	11			
	Heifers under 1 year	49	19			
	Bulls over 1 year	21	9			
	Steers over 1 year	0	0			
Repro. perf.	Percent pregnant[2]	82.8	78.3			
	Calf survival percent[3]	89.6	86.1			
Wean perf.	Adj. ADG[4]	1.99	1.65			
	Av. type sc.[5]	12.46	10.87			
Postweaning performance	No. of bulls	9	4			
	No. of heifers	39	8			
	No. of steers	31	6			
Slaughtered	No. of bulls	0	0			
	No. of heifers	0	0			
	No. of steers	31	6			
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

S-10-1 (Rev.)
4-70

UNIVERSITY OF TENNESSEE
Agricultural Experiment Station
Knoxville, Tennessee

I. PROJECT: H-306 (S-10)

Effects of selection to improve growth rate in beef cattle.

II. OBJECTIVES:

1. To measure the effectiveness of selection to improve growth rate to a year of age and the effects such selection will have on other traits.

2. To investigate phenotypic and genetic relationship between growth rate and other variables.

3. To investigate various methods of improving the accuracy of assessment of growth rate.

4. To study inbred beef cattle with the aid of immunogenetic markers.

III. PERSONNEL:

R. R. Shrode, C. S. Hobbs, J. A. Odom, J. H. Felts, and W. T. Butts, Jr.

IV. ACCOMPLISHMENTS DURING THE YEAR:

Mating systems and selection procedures in the Angus herd at the Plateau Experiment Station (Crossville), and the Hereford herd at the Tobacco Experiment Station (Greeneville), were changed during the year from those specified in the previous project (H-61), to those described in the statement of the current project. The Angus herd is now carried as three 60-cow, 4-sire groups--one an inbred group constituted from the previously existing inbred herd, one a "selection" group, and one a control group. Selection in the inbred group and in the "selection" group is on the basis of average daily gain to a year of age, adjusted for fat thickness. Replacement heifers are bred at a year of age and bulls are used as two-year-olds. The control herd is randomly perpetuated. Occasional cases of extreme unsoundness and/or obvious low probability of reproduction will constitute grounds for culling. The Hereford herd is carried as a 100-cow, 5-sire herd, the bulls used in a given season to be two newly selected yearlings, two 2-year-olds used the previous year, and one 3-year-old used in the two previous years, chosen largely on the basis of reproductive performance. This repeated use of sires plus repeat matings will provide control information. Selection procedures are the same as those used in the inbred and "selection" Angus groups. In all groups mature cows are to be removed on the basis of age to maintain as low an average age as possible and thus shorten generation interval.

Analyses of data to determine the usefulness of various body measurements in predicting postweaning performance of calves reported on a preliminary basis in 1969, were completed. Dependent variables were postweaning average daily gain (from weaning to approximately a year of age), average daily gain from birth to approximately a year of age, condition score at approximately a year of age, and

ultrasonically measured fat thickness at approximately a year of age. Numerous regression equations were derived using a stepwise multiple regression procedure. Independent variables that could be entered into a multiple regression equation were hearth girth, back length, loin length, rump length, total length, type score, condition score, weight and age--all recorded at six different times from birth to approximately a year of age. Ultrasonically measured fat thickness measured at weaning (about 225 days average weaning age), was available also as an independent variable. Combinations of independent variables recorded at weaning were significantly superior (in predicting the dependent variables) to combinations of those recorded at earlier ages. The results clearly indicate that certain body dimension measurements and estimates of fatness can be used effectively to improve prediction of subsequent calf performance and body composition over the prediction attainable using conventional methods based on only calf weight and age.

V. FUTURE PLANS:

Continuation of planned procedures and accumulation of data to contribute to accomplishment of objectives 1, 2, and 3.

Blood typing will be continued to the point that annually recorded blood types will be only those of the current calf crop. Hopefully, this point will be reached during the coming year.

VI. PUBLICATIONS DURING THE YEAR:

Brown, W. L. 1969. Preweaning body measurements of beef calves and traits of their dams as predictors of calves' postweaning and lifetime performance. Ph.D. D ssertation. University of Tennessee.

Shrode, R. R., W. L. Brown, and C. S. Hobbs. 1969. Cow weight, cow weight change, and calf traits in an Angus herd. J. Animal Sci. 29:112. (Abstr.).

VII. PUBLICATIONS PLANNED:

Shrode, R. R., W. L. Brown, S. P. Hammack, and C. S. Hobbs. Correlation of beef cows' own weaning performance with weaning performance of their offspring and grand offspring.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Tennessee

Location		Crossville	Crossville	Greeneville		
Breed of sire		Angus	Angus	P. Hereford		
Breed of dam		Angus	Angus	P. Hereford		
Line or group[1]		Inbred	Non-Inbred	- -		
Percent used in project		100	100	100		
Inventory as of July 1, 1970	Cows 2 years and over	49	150	90		
	Yearling heifers	9	37	9		
	Bulls and steers under 1 year	20	60	36		
	Heifers under 1 year	25	46	31		
	Bulls over 1 year	4	66	13		
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]	80	85	91		
	Calf survival percent[3]	85	90	79		
Wean perf.	Adj. ADG[4]	1.78	1.93	1.64		
	Av. type sc.[5]	11.9	12.3	12.3		
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

S-10-1 (Rev.)
4-70

TEXAS A&M UNIVERSITY
Agricultural Experiment Station
College Station, Texas

I. PROJECT: S-1547

Genetics of qualitative characters in beef cattle.

II. OBJECTIVES:

To estimate genetic parameters and genetic-environmental interactions of biological and economic traits.

III. PERSONNEL:

D. F. Weseli (leader) and T. C. Cartwright

IV. ACCOMPLISHMENTS DURING THE YEAR:

Blood typing cattle in the S-10 project herd. The main emphasis was on obtaining blood types of all animals at the Livestock and Forage Research Center, McGregor, Texas. To date, 495 animals have been typed at this station. All mature animals should be completed during 1970. Hemoglobin type of these animals is being assessed and serum transferrin type will be determined as well as red cell typing.

Development of the red cell typing reagents. Less emphasis will be placed in this phase of the work since the present reagent bank is now fairly adequate. Several B, C, and S system reagents are still needed and efforts will be made to produce them.

V. FUTURE PLANS:

Blood typing of animals in cooperating S-10 herds of Texas, Virginia, and Tennessee will continue. Preliminary analyses of gene frequency data within some subpopulations should be possible during the forthcoming year. A program to summarize blood typing data will be developed.

VI. PUBLICATIONS PLANNED:

Inheritance and biochemical properties of αs_1-casein and β-casein variants in Hereford and Brahman populations in Texas.

Gene frequency and genetic associations of serum transferrins and hemoglobins in beef cattle.

I. PROJECT: 1646

Qualitative genetic differences in cattle and pleiotropic effects.

II. OBJECTIVES:

The specific research being conducted under the above project is entitled "Characterization of the double muscle syndrome: Its genetics, anatomy, physiology, meat chemistry and carcass qualities". The objectives are:

1. To determine the number of gene pairs involved in the transmission of the double muscle syndrome and the degree to which modifying genes may alter the action of the basic genes involved.

2. To delineate all traits comprising the double muscle syndrome as to their nature, interrelationships, concomitance and effect on the overall fitness of the individual.

3. To elucidate muscle chemistry, physiology and meat quality.

4. To study the musculature of double muscled animals in quest of consistent departures from normalcy other than in size. The skeletal attachments, nerve innervation and relative blood supply of the muscles will be examined in detail.

III. PERSONNEL:

N. M. Kieffer (leader) and T. C. Cartwright

IV. ACCOMPLISHMENTS DURING THE YEAR:

The double muscled herd at Texas A&M University consists of 11 females and three bulls of breeding age and two heifer calves. These animals represent three breeds and two breed crosses. Six double muscled calves have been born within this herd since October 1969. One calf was born without assistance, one was taken by Caesarean Section, and four were lost due to dystocia. The calf born without assistance weighed 25 kg as did the calf taken by Caesarean Section. The others weighed from 40 to 44 kg. One cow died from injuries sustained during calving. All calves were sired by a double muscled Charolais bull.

V. FUTURE PLANS:

One hundred and twenty-four non-double muscled cows which are thought to be free of inheritance for double muscling are being bred to three double muscled Charolais bulls during the 1970 breeding season. The females resulting from these matings will be bred to bulls heterozygous for double muscling. The offspring (F_2 generation) will be evaluated for Mendelian ratios in an effort to pin down the number of major gene pairs and kind of gene action involved in the expression of the double muscled syndrome. Approximately 20 steers will be fed in the feedlot and then followed through the meats laboratory. Production, muscle chemistry and meat quality data will be obtained.

I. PROJECT: H-2102

Breeding methods for beef cattle in the southern region.

II. OBJECTIVES:

To estimate genetic parameters and genetic-environmental interactions of biological and economic traits.

III. PERSONNEL:

N. M. Kieffer (leader) and T. C. Cartwright

IV. ACCOMPLISHMENTS DURING THE YEAR:

The major effort in the Cytogenetics laboratory during the past year has involved a cytogenetic analysis of intersexuality in the bovine. This work has been completed to a point and a manuscript has been prepared for publication. The following abstract of this study which is in press in the Journal of Animal Science summarizes the results obtained:

The genetic sex was determined for three bovine intersexes by chromosomal analysis. Histological observations were made on tissue from certain of the genital organs. Two of the animals, although of opposite genetic sex were true hermaphrodites. The third was a co-twin to a normal bull and was a freemartin with genital organs of male type and only their presentation outside the pelvic cavity differed markedly from a normal bull. No vestiges of female organs existed. Testicular tissue having XX sex chromosomes was histologically identical to testicular tissue having XY sex chromosomes. Thus, sex chromosome composition *per se* does not necessarily determine cell type. The data suggest that "genes or factors" for sex determination are not limited to the sex chromosomes, but are also located on the autosomes. It also appears that early sexual bi-potentiality of an individual is due to each individual having sets of both male and female sex "genes or factors". Whether an individual develops along the lines of maleness or femaleness is probably due to the selective derepression of sets of "sex genes or factors" under the control of a regulator molecule. Thus, the possibility exists that a genetic female could, for example, be induced by manipulation of the regulator to develop into a functionally phenotypic male. Such an individual would sire all female offspring.

V. PUBLICATIONS:

Kieffer, Nat M. and A. M. Sorensen, Jr. 1970. Cytogenetics of intersexuality in the bovine. J. Animal Sci. (Abstr.) (In press).

I. PROJECT: H-2101

Breeding methods for beef cattle in the southern region.

II. OBJECTIVES:

To estimate genetic parameters and genetic-environmental interactions of biological and economic traits.

III. PERSONNEL:

T. C. Cartwright (leader), H. A. Fitzhugh, Jr., and R. C. Thomas

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Factors influencing preputial prolapse in yearling bulls.

Chronic prolapse of the parietal layer of the prepuce of bulls may lead to preputial injuries and related breeding difficulties. The tendency to prolapse was subjectively scored for 113 yearling, second cross (3/4 Santa Gertrudis, 1/4 British) bulls. Length of sheath, internal diameter of preputial orifice, external circumference of sheath and body weight were also determined. Variation among these traits associated with breed of maternal granddam (Hereford, Angus, Shorthorn, or Red Angus), sire and age at measurement was examined.

Statistically significant ($P<.05$) differences were found for preputial prolapse score among base breeds and sires, indicating that culling bulls with a predisposition to prolapse should decrease the frequency of this trait in the breeding population. The significant ($P<.05$) correlation between sheath length and prolapse score, independent of base breed, sire and age, was 0.33 and supported other reports that long sheaths were associated with increased preputial prolapse.

2. Variation in intrinsic efficiency of feed utilization.

A total of 87 Hereford steers, including 18 paternal half-sib groups, were individually fed a standard ground ration in eight trials. Each trial lasted 32 weeks. Daily feed allotments were restricted to the expected minimum consumption of any contemporary steer. The mean weekly feed consumption was 47.2 kg with a phenotypic CV of 1.7%. The mean weekly weight gain was 5.1 kg with a phenotypic CV of 9%. Since variation in feed consumption among contemporary steers was essentially eliminated by the experimental feeding regime, variation in weight gain provided direct evidence of differences in intrinsic efficiency of feed utilization for growth and maintenance.

Variation among paternal half-sib groups for average weekly gain was significant ($P<.05$). The estimate of heritability for weekly gain, independent of appetite, was $1.28 \pm .66$. These results suggested that additive genetic variation did exist for intrinsic efficiency of feed utilization.

3. Efficiency of alternative beef breeding systems - simulated.

The potential benefits of crossbreeding encompass more than hybrid vigor. The opportunity to match breeds in complementary combinations which optimize the efficiency of beef production may equal or exceed benefits from heterosis. One major factor influencing production efficiency is the nutrient requirement for growth, lactation and maintenance. In this study, the measure of production efficiency used was the amount of beef produced per unit of total digestible nutrients (TDN). Three simulated alternative breeding programs for commercial beef production were compared on the basis of total TDN required and beef produced over nine successive years and for the efficiency of TDN utilization for beef production.

The three assumed alternative breeding programs for commercial beef production were:

1) Purebred. Purebred cows weighed 948 lb. at 5 years. When bred to bulls of the same breeding, these cows produced slaughter progeny weighing 384 lb. at 6 months and 692 lb. at 12 months of age.

2) Rotational. In the 3-breed rotational cross, purebred cows, weighing 948 lb. at 5 years, were mated to bulls of the second breed to produce sale progeny weighing 430 and 875 lbs. at 6 and 12 months. The two-breed cross replacement females, weighing 1014 lb. at 5 years, were mated to bulls of the third breed to produce sale progeny weighing 448 and 937 lb. at 6 and 12 months. The three-breed cows, weighing 1102 lb. at 5 years, were then mated to bulls of the original breed. Their progeny, and all subsequent progeny, performed similarly to those of the two-breed cross dams.

3) Three Breed Cross. The specialized sire and dam system utilized small cows bred to large bulls. The base herd of purebred cows, weighing 948 lb. at 5 years, were first mated to bulls of a small breed, such as the Jersey, to produce a special line of small crossbred cows weighing 816 lb. at 5 years. The sale progeny from this initial cross weighed 320 and 657 lb. at 6 and 12 months. Small replacement females were subsequently produced from crisscrossing the two original small breeds, e.g. Angus and Jersey. These small crossbred cows, weighing 816 lb. at 5 years, were mated to bulls of a third breed, noted for high growth rate, to produce sale progeny weighing 441 and 893 lb. at 6 and 12 months. All progeny, male and female, from the small dam-large sire cross were sold for beef.

Consider the dilemma of choosing among these alternatives. The necessary information for a correct choice can only be obtained from long term simultaneous comparisons requiring extensive research facilities. In the intervening decades, commercial cattlemen may be utilizing inefficient programs which limit total beef productivity and profitability. An interim solution involves the computer simulation of beef herds, including prediction of the amount and nutrient costs of beef production based on currently available information. Such simulated beef programs could incorporate both fixed and

variable costs, the amount of improvement expected from selection and hybrid vigor and other factors influencing production efficiency. In this initial study the primary sources of variation among the three alternative programs were growth rate, milk production, mature size, and the related nutrient requirements. Average production records of contemporary Angus, Hereford, Brown Swiss x Hereford and Angus x Jersey herds from the Texas A&M Research Center at McGregor provided the basic data for these simulated programs.

Conditions common to all three programs:

1) Each program initiated from the same base herd of 1000 3-year old purebred females. All 1000 females calved at the start of year 1. The sire of calf depends on the system.

2) Each program was terminated at the end of the ninth year, and all breeding females were inventoried at their salvage value for beef.

3) All replacement females were produced within the operation. The cost of purchasing and/or raising replacement sires was assumed equal in all three programs.

4) The number of breeding females carried in all three programs was fixed at 1000 head.

5) The average age at first calving was 24 months with an average calving interval of 12 months. The percent calves weaned based on cows exposed was 85 percent.

6) Five percent of potential replacement females were culled prior to first calving.

7) Sale price per unit weight of sale calves and at 6 and 12 months salvaged cows was equal in all programs. Salvage value equaled 2/3 the sale value for calves per unit weight.

Replacement criteria:

1) Annual attrition rate among females entering herd at the same time was 11 percent.

2) Annual replacement rate for herd was 20 percent.

3) The median number of calves produced per cow was 4.5.

4) Crossbred cows replaced purebred cows as quickly as they became available. In other words, as pregnant crossbred heifers became available in the rotational and specialized cross programs, they were automatically substituted for purebred cows. Consequently, there was a more rapid replacement rate in the initial stages of the two crossbreeding programs than implied in the above replacement criteria 1, 2, and 3.

Values used to estimate TDN requirements:

1) Weight gains - the amount of TDN required per daily weight gain was estimated from the formula, $TDN = 0.022\ W^{3/4}\ G$, where W is body weight and G is gain. TDN, W, and G were measured in pounds.

2) Weight maintenance - the amount of TDN required per day for weight maintenance was estimated from the formula, $TDN = 0.037\ W^{3/4}$.

3) Lactation - 1.88 pounds TDN were required to produce one pound of TDN in milk.

4) Pregnancy - 353 pounds of TDN were required per pregnancy.

Growth curves for the four types of breeding females indicate the correlated differences in growth rate and mature size, highlighted by the difference of 286 pounds in weight at 5 years between the small crisscross cows and the moderately heavy 3-breed cross cows. Two factors contributed to differences in the growth of progeny from each system: milk production of their dams and inherited growth potential. For example, calves from small crisscross cows and large bulls were similar in birth weight to calves from the same cows but small bulls. However, by six months the calves with large sires were the second heaviest of all five types; whereas, calves with small sires were still the lightest of the five types. Apparently, calves with large sires had the inherent growth potential to take full advantage of the milk production of their dams.

The TDN required each year for the following functions was totaled and then cumulated over the 9-year period.

1) Growth and maintenance of breeding cows.

2) Pregnancy and lactation.

3) Growth of sale progeny to 6 and 12 months.

More TDN was required for the 9-year period by the rotational systems regardless of the age of disposal of sale progeny. When progeny were sold at 6 months, the rotational system (R6) required 13.9 percent more TDN than the special cross (S6); however, when progeny were sold at 12 months, the rotational system (R12) required 17.5 percent more TDN than S12. The special cross (S6) required 2.4 percent less TDN than the purebred system when calves were sold at 6 months, but this ranking changed when progeny sold as yearlings when the total TDN for S12 was 0.9 percent more than for P12.

Two general programs were considered for beef production. One was the sale of weaning calves (6 months), and the other was the sale of yearling cattle in all three breeding systems from the yearling program. For example, sale of calves at 6 months from the rotational system yielded a total beef production for the first 9 years of 3,725,011 pounds vs. 6,410,969 pounds when calves were sold at 12 months.

Beef produced from sale of culled cows (weighed at 2/3 the value of calf beef), was included in the total beef produced for all three systems. This source of beef production contributed to the sharp rise at year 3 for both crossbred systems because the first group of crossbred heifers replaced purebred cows at this time. All cattle were inventoried at beef value at the end of the ninth year.

Through the ninth year the rotational cross system had yielded 16.9 percent and 25.8 percent more beef than the purebred system for calves sold at 6 and 12 months, respectively. The special cross system had also produced more beef than the purebred system through the ninth year. The advantages for the special cross were 3.3 percent and 8.8 percent for sale of calves at 6 and 12 months.

The ratio of cumulative total beef produced to cumulative total TDN required was the measure of efficiency used to compare the three breeding systems. The purebred system was considerably more efficient in the early years than either of the cross systems. This purebred advantage resulted from increased TDN costs of rapid replacement of purebred cows with crossbred heifers. The extra TDN required to grow and develop crossbred heifers did not immediately yield comparable increases in beef production. Once again, the importance of longevity of breeding females is apparent.

Considering for the moment efficiency through the first nine years only, the special cross was more efficient than either the rotational or purebred system. The advantages for sale of calves at 6 months were 2.4 percent and 5.8 percent over the rotational and purebred systems. When calves were sold at 12 months, the advantages for the special cross were 1.6 percent and 7.7 percent over the rotational and purebred systems. The relatively poor postweaning growth rate of the progeny from small bulls - small cows, which were a byproduct of producing the small crisscross replacement heifers, contributed to the decreased advantage of the special cross over the rotational cross.

The ranking of the breeding systems for the traits considered in this study - TDN required, beef produced and beef/TDN - depended primarily on the differences in size of the breeding females in each system and the differences in inherent growth potential of their progeny. The rotational system utilized the heaviest cows, produced the most beef, required the most TDN and was more efficient than the purebred system but less efficient than the special cross (3-breed). The special cross, which utilized the smallest cows, was the most efficient of the systems in terms of beef produced per TDN required.

These relationships among the breeding systems might vary if different assumptions were used for such traits as calving percent, attrition rate, and the value of cow and calf beef. It should also be noted that the advantages of hybrid vigor were largely disregarded in this study. Hybrid vigor for fertility, growth rate and milk production would augment the advantages of the crossbred systems over the purebred program.

Many factors, not considered in this study, contribute to the efficiency of beef production. For example, costs of producing beef, in addition to TDN, which varies with cow size, include labor, breeding costs, etc., which are

essentially the same regardless of cow size. Consideration of such fixed costs would tend to reduce the advantage of the small cow. However, there are other fixed costs such as fertilizer, corrals and other improvements which tend to vary with the unit of land and not the number of cows. If the unit of land could support 1000 moderately large rotational cross cows, it might have supported 1250 of the small special cross cows (estimated from the ratio of TDN requirements for maintenance).

The results of this initial comparison of alternative beef breeding systems should be carefully considered in light of experience. Projections of the costs and returns of beef production, simulated from currently available information and based on often arbitrary assumptions, are a poor substitute for experimentally verified comparisons. However, they can be a useful tool to aid decisions before experimental verification becomes available.

V. FUTURE PLANS:

Data from the "cow size" work will be analyzed. Data include individual feed consumption of cows and calves up to slaughter, body weight, measurements, milk production, and carcass composition.

A study of the use of nonlinear models to describe weight-age relationships in cattle is well under way and will be given major effort to complete by September 1970.

The project will be reorganized and rewritten. The first draft is expected by January 1971.

VI. PUBLICATIONS DURING THE YEAR:

Joandet, G. E. and T. C. Cartwright. 1969. Estimation of efficiency of beef production. J. Animal Sci. 29:862-868.

Cartwright, T. C. 1970. Selection criteria for beef cattle for the future. J. Animal Sci. 30:706-711.

Long, C. R. And H. A. Fitzhugh. 1969. Comparison of alternative beef breeding programs. J. Animal Sci. 28:109. (Abstr.)

Fitzhugh, H. A. And T. C. Cartwright. 1969. Growth of cattle with restricted feed intake. J. Animal Sci. 29:107. (Abstr.).

Franke, D. E. and T. C. Cartwright. 1969. Estimating optimum slaughter weights of steers of different genetic potentials. J. Animal Sci. 28:130. (Abstr.).

Brown, J. E. and T. C. Cartwright. 1969. Combining ability for postweaning gain. J. Animal Sci. 29:105. (Abstr.).

Lagos, F. and H. A. Fitzhugh, Jr. 1969. Factors influencing conception rate of beef cows. J. Animal Sci. 29:192. (Abstr.).

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		A	B	H	L	G
Breed of dam		A	B	H	L	G
Line or group[1]		Purebred	Purebred	Purebred	Purebred	Purebred
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over	49	18	105	30	
	Yearling heifers	12	2	31	5	
	Bulls and steers under 1 year	6	5	23	8	
	Heifers under 1 year	17	4	42	4	
	Bulls over 1 year	6	7	18	13	2
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]	95	78	83	73	
	Calf survival percent[3]	91	73	80	56	
Wean perf.	Adj. ADG[4]	2.0	2.2	2.0	2.3	
	Av. type sc.[5]					
Postweaning performance	No. of bulls	15	5	20	14	
	No. of heifers	12	2	31	10	
	No. of steers			4		
Slaughtered	No. of bulls			8	6	
	No. of heifers			11	5	
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: Age only 180 days.

5 - Suggest S-10 scoring system; indicate if different.

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Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Texas

	Location	McGregor	McGregor	McGregor	McGregor	McGregor
	Breed of sire	J	BS	A	A	H
	Breed of dam	J	BS	J	A	H
	Line or group[1]	Purebred	Purebred	Grade	Grade	Grade
	Percent used in project	100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over	12		43	23	104
	Yearling heifers			3		18
	Bulls and steers under 1 year			6		11
	Heifers under 1 year			5		4
	Bulls over 1 year	2	1	2		
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]			94		83
	Calf survival percent[3]			90		81
Wean perf.	Adj. ADG[4]			1.7		1.9
	Av. type sc.[5]					
Postweaning performance	No. of bulls			2		25
	No. of heifers			3		19
	No. of steers			1		4
Slaughtered	No. of bulls					2
	No. of heifers					5
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

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Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		A	A	A	B	B
Breed of dam		H	24x	82x	H	25x
Line or group[1]		Grade	Grade	Grade	Grade	Grade
Percent used in project		100	100	100	100	100
Inventory as of July 1,	Cows 2 years and over					4
	Yearling heifers					
	Bulls and steers under 1 year	1	3		6	
	Heifers under 1 year		2	1	6	
	Bulls over 1 year					
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]					
	Calf survival percent[3]					
Wean perf.	Adj. ADG[4]	2.1				
	Av. type sc.[5]					
Postweaning performance	No. of bulls					
	No. of heifers	6				
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

S-10-1 (Rev.)
4-70

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		B	B	H	H	L
Breed of dam		23x	24x	57x	105x	H
Line or group[1]		Grade	Grade	Grade	Grade	Grade
Percent used in project		100	100	100	100	100
Inventory as of July 1,	Cows 2 years and over	6	5	7		9
	Yearling heifers	3	2			4
	Bulls and steers under 1 year					7
	Heifers under 1 year				3	7
	Bulls over 1 year					
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]	67	80	100		88
	Calf survival percent[3]	67	80	100		75
Wean perf.	Adj. ADG[4]	1.9	2.2	2.3		2.2
	Av. type sc.[5]	1	2	4		8
Postweaning performance	No. of bulls	3	2	3		4
	No. of heifers			2		4
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

S-10-1 (Rev.)
4-70

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Texas

	Location	McGregor	McGregor	McGregor	McGregor	McGregor
	Breed of sire	L	L	L	L	L
	Breed of dam	1x	15x	72x	73x	16x
	Line or group[1]	Grade	Grade	Grade	Grade	Grade
	Percent used in project	100	100	100	100	100
Inventory as of July 1,	Cows 2 years and over	7	6	2	2	2
	Yearling heifers		1	3		
	Bulls and steers under 1 year				1	
	Heifers under 1 year			1	1	
	Bulls over 1 year					
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]		100	100		
	Calf survival percent[3]		100	75		
Wean perf.	Adj. ADG[4]		2.1	2.0		
	Av. type sc.[5]					
Postweaning performance	No. of bulls					
	No. of heifers		1	3		
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

S-10-1 (Rev.)
4-70

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Texas

	Location	McGregor	McGregor	McGregor	McGregor	McGregor
	Breed of sire	L	L	L	L	L
	Breed of dam	82x	A	57x	58x	105x
	Line or group[1]	Grade	Grade	Grade	Grade	Grade
	Percent used in project	100	100	100	100	100
Inventory as of July 1,	Cows 2 years and over	1	2			
	Yearling heifers		4			
	Bulls and steers under 1 year		13	3	2	3
	Heifers under 1 year		3	5	7	4
	Bulls over 1 year					
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]	100	95			
	Calf survival percent[3]	100	86			
Wean perf.	Adj. ADG[4]	1.9	1.8		2.3	1.9
	Av. type sc.[5]					
Postweaning performance	No. of bulls		3		2	7
	No. of heifers	1	6		2	6
	No. of steers		2		1	2
Slaughtered	No. of bulls		7			7
	No. of heifers		6			6
	No. of steers					

Remarks

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

S-10-1 (Rev.)
4-70

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		L	L	G	G	G
Breed of dam		59x	200x	H	57x	58x
Line or group[1]		Grade	Grade	Grade	Grade	Grade
Percent used in project		100	100	100	100	100
Inventory as of July 1,	Cows 2 years and over					
	Yearling heifers					
	Bulls and steers under 1 year	1		15	8	4
	Heifers under 1 year	5	3	3		3
	Bulls over 1 year					
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]					
	Calf survival percent[3]					
Wean perf.	Adj. ADG[4]		1.7	2.1	2.3	2.1
	Av. type sc.[5]					
Postweaning performance	No. of bulls		1	7	4	3
	No. of heifers		1	3	4	2
	No. of steers		1	1	1	
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

S-10-1 (Rev.)
4-70

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Texas

	Location	McGregor	McGregor	McGregor	McGregor	McGregor
	Breed of sire	G	G	G	BS	BS
	Breed of dam	250x	16x	15x	1x	H
	Line or group[1]	Grade	Grade	Grade	Grade	Grade
	Percent used in project	100	100	100	100	100
Inventory as of July 1,	Cows 2 years and over				23	20
	Yearling heifers					9
	Bulls and steers under 1 year	2	2	1		3
	Heifers under 1 year			3		5
	Bulls over 1 year					
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]				100	100
	Calf survival percent[3]				100	94
Wean perf.	Adj. ADG[4]			2.3	2.3	2.2
	Av. type sc.[5]					
Postweaning performance	No. of bulls			1	1	7
	No. of heifers			1		9
	No. of steers				1	1
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					

Remarks

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Texas

Location		McGregor	McGregor	McGregor	McGregor	McGregor
Breed of sire		BS	BS	BS	T	H
Breed of dam		A	16x	15x	H	B
Line or group[1]		Grade	Grade	Grade	Grade	Grade
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over	4				
	Yearling heifers	2				
	Bulls and steers under 1 year	7	1	1	4	
	Heifers under 1 year	7	1	2	11	
	Bulls over 1 year					
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]	100				
	Calf survival percent[3]	91				
Wean perf.	Adj. ADG[4]	2.0		2.1		2.1
	Av. type sc.[5]					
Postweaning performance	No. of bulls	4		1		2
	No. of heifers	3				1
	No. of steers	3				
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

S-10-1 (Rev.)
4-70

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Texas

Location		McGregor	McGregor	McGregor		
Breed of sire		BS	BS	BS		
Breed of dam		250x	B	42x		
Line or group[1]		Grade	Grade	Grade		
Percent used in project		100	100	100		
Inventory as of July 1,	Cows 2 years and over					
	Yearling heifers					
	Bulls and steers under 1 year					
	Heifers under 1 year					
	Bulls over 1 year					
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]					
	Calf survival percent[3]					
Wean perf.	Adj. ADG[4]	2.2	2.0	2.2		
	Av. type sc.[5]					
Postweaning performance	No. of bulls					
	No. of heifers	1	1	2		
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

S-10-1 (Rev.)
4-70

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Texas

Location		McGregor	McGregor	McGregor		
Breed of sire		H	H	H		
Breed of dam		15x	25x	A		
Line or group[1]		Grade	Grade	Grade		
Percent used in project		100	100	100		
Inventory as of July 1,	Cows 2 years and over					
	Yearling heifers					
	Bulls and steers under 1 year					
	Heifers under 1 year					
	Bulls over 1 year					
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]					
	Calf survival percent[3]					
Wean perf.	Adj. ADG[4]	2.1	1.8	2.1		
	Av. type sc.[5]					
Postweaning performance	No. of bulls	2	1	1		
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

S-10-1 (Rev.)
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CATTLE BREED & CROSS CODES

Breed or Cross	Dam Breeding	Sire Breeding	Progeny Breeding
A	Angus	Angus	Angus
B	Brahman	Brahman	Brahman
BA	Brangus	Brangus	5/8 A - 3/8 B
BM	Beefmaster	Beefmaster	S - H - B
BS	Brown Swiss	Brown Swiss	Brown Swiss
C	Charbray	Charbray or Charolais	3/4, 7/8 L - 1/4, 1/8 B
G	Santa Gertrudis	Santa Gertrudis	Santa Gertrudis
H	Hereford	Hereford	Hereford
I	Holstein	Holstein	Holstein
J	Jersey	Jersey	Jersey
L	Charolais	Charolais	Charolais
R	Red Poll	Red Poll	Red Poll
RA	Red Angus	Red Angus	Red Angus
RB	Red Brangus	Red Brangus	Red Brangus
S	Shorthorn	Shorthorn	Shorthorn
U	Sussex	Sussex	Sussex
1x	Hereford	Brahman	1/2 H - 1/2 B
2x	Brahman	Hereford	1/2 B - 1/2 H
3x	1x & 2x	Hereford	3/4 H - 1/4 B
4x	1x	Brahman	3/4 B - 1/4 H
5x	3x & 9x	Hereford	7/8 H - 1/8 B
6x	Angus breeding, predominate		

Breed or Cross	Dam Breeding	Sire Breeding	Progeny Breeding
7x	Brahman	1x & 2x	3/4 B - 1/4 H
8x	4x & 23x	Hereford	5/8 H - 3/8 B
9x	Hereford	1x & 2x	3/4 H - 1/4 B
10x	3x, 5x & 9x	Charolais	5/8 L - 3/8 H
11x	Hereford	Santa Gertrudis	1/2 H - 1/2 G
12x	Hereford	Red Poll	1/2 H - 1/2 R
13x	1x	Santa Gertrudis	1/2 G - 1/4 H - 1/4 B
14x	1x	Red Poll	1/2 RP - 1/4 H - 1/4 B
15x	Hereford	Charolais	1/2 H - 1/2 L
16x	1x & 2x	Charolais	1/2 L - 1/4 H - 1/4 B
17x	Charbray	Hereford	1/2 C - 1/2 H
18x	Santa Gertrudis breeding, predominate		
19x	Brahman breeding, predominate		
20x	Charolais or Charbray breeding, predominate		
21x	1x	1x & 2x	1/2 H - 1/2 B (<u>inter</u> <u>se</u>)
22x			
23x	4x	Brahman	7/8 B - 1/8 H
24x	23x	Brahman	15/16 B - 1/16 H
25x	24x	Brahman	31/32 B - 1/32 H
26x	Hereford	Charbray	1/2 H - 7/16 L - 1/16 B
27x	26x	Charolais	3/4 L - 1/4 H
28x	27x	Charolais	7/8 L - 1/8 H
29x	28x	Charolais	15/16 L - 1/16 H
30x			
31x			

Breed or Cross	Dam Breeding	Sire Breeding	Progeny Breeding
32x	11x	Santa Gertrudis	3/4 G - 1/4 H
33x	32x	Santa Gertrudis	7/8 G - 1/8 H
34x	33x	Santa Gertrudis	15/16 G - 1/16 H
35x			
36x	Brahman	Charbray	9/16 B - 7/16 L
37x	36x	Charolais	3/4 L - 1/4 B
38x	37x	Charolais	7/8 L - 1/8 B
39x	38x	Charolais	15/16 L - 1/16 B
40x			
41x			
42x	13x	Santa Gertrudis	3/4 G - 1/8 H - 1/8 B
43x	42x	Santa Gertrudis	7/8 G - 1/16 H - 1/16 B
44x	43x	Santa Gertrudis	15/16 G - 1/32 H - 1/32 B
45x	58x	Hereford	3/4 H - 1/4 BS
46x	58x	Brown Swiss	3/4 BS - 1/4 H
47x	10x	Charolais	13/16 L - 3/16 H
48x	47x	Charolais	29/32 L - 3/32 H
49x			
50x			
51x	Red Poll	Santa Gertrudis	1/2 R - 1/2 G
52x	51x	Santa Gertrudis	3/4 G - 1/4 R
53x	52x	Santa Gertrudis	7/8 G - 1/8 R
54x	53x	Santa Gertrudis	15/16 G - 1/16 R
55x			
56x	B	Brown Swiss	1/2 B - 1/2 BS

Breed or Cross	Dam Breeding	Sire Breeding	Progeny Breeding
57x	1x	Brown Swiss	1/2 BS - 1/4 H - 1/4 B
58x	H	Brown Swiss	1/2 BS - 1/2 H
59x	57x	Hereford	1/4 BS - 5/8 H - 1/8 B
60x	57x	Brown Swiss	3/4 BS - 1/8 H - 1/8 B
61x	14x	Santa Gertrudis	1/2 G - 1/4 R - 1/8 H - 1/8 B
62x	61x	Santa Gertrudis	3/4 G - 1/8 R - 1/16 H - 1/16 B
63x	62x	Santa Gertrudis	7/8 G - 1/16 R - 1/32 H - 1/32 B
64x	63x	Santa Gertrudis	15/16 G - 1/32 R - 1/64 H - 1/64 B
65x			
66x	1x & 2x	Charbray	7/16 L - 1/4 H - 5/16 B
67x	66x	Charolais	3/4 L - 1/8 H - 1/8 B
68x	67x	Charolais	7/8 L - 1/16 H - 1/16 B
69x	68x	Charolais	15/16 L - 1/32 H - 1/32 B
70x			
71x	15x	Charbray	11/16 L - 1/4 H - 1/16 B
72x	15x	Charolais	3/4 L - 1/4 H
73x	72x	Charolais	7/8 L - 1/8 H
74x	73x	Charolais	15/16 L - 1/16 H
75x			
76x	3x, 5x, & 9x	Charbray	7/16 L - 3/8 H - 3/16 B
77x	76x	Charolais	3/4 L - 3/16 H - 1/16 B
78x	77x	Charolais	7/8 L - 3/32 H - 1/32 B
79x	78x	Charolais	15/16 L - 3/64 H - 1/64 B

Breed of Cross	Dam Breeding	Sire Breeding	Progeny Breeding
80x			
81x	16x	Charbray	15/32 L - 1/4 H - 9/32 B
82x	16x	Charolais	3/4 L - 1/8 H - 1/8 B
83x	82x	Charolais	7/8 L - 1/16 H - 1/16 B
84x	83x	Charolais	15/16 L - 1/32 H - 1/32 B
85x			
86x	13x	Charbray	7/16 L - 1/4 G - 1/8 H - 3/16 B
87x	86x	Charolais	3/4 L - 1/8 G - 1/32 H - 3/32 B
88x	87x	Charolais	7/8 L - 1/16 B - 1/64 H - 3/64 B
89x	88x	Charolais	15/16 L - 1/32 G - 1/128 H - 3/128 B
90x	89x	Charolais	
91x	Brahman	Charolais	1/2 L - 1/2 B
92x	91x	Charolais	3/4 L - 1/4 B (Charbray)
93x	92x	Charolais	7/8 L - 1/8 B (Charbray)
94x	93x	Charolais	15/16 L - 1/16 B
95x	Coop. cattle		5/8 L - 1/4 B - 1/8 S
96x	Coop. cattle		1/4 R - 1/4 B - 1/8 H - 1/8 J
97x	Coop. cattle		3/4 H - 1/4 B (approx.)
98x	Coop. cattle		R - B
99x	Coop. cattle		B - J
100x	1x	Angus	

VIRGINIA POLYTECHNIC INSTITUTE
Animal Science Department
Blacksburg, Virginia

I. PROJECT: 206100 (S-10)

Heterosis from crosses among British breeds of beef cattle.

II. OBJECTIVES:

To measure heterosis obtained from crosses among the Angus, Hereford, and Shorthorn breeds, as shown by growth rate, fattening ability, and carcass quality.

To compare straightbred cows with crossbred cows on the basis of lifetime production.

III. PERSONNEL:

M. B. Wise, F. S. McClaugherty, J. S. Copenhaver, R. C. Carter, W. H. McClure and J. A. Gaines

IV. ACCOMPLISHMENTS DURING THE YEAR:

The second calf crop of the "interim" phase (between phases two and three) was born beginning in early spring, and weaned on 27 October 1969. Following weaning the steers were placed on full feed; some of the heifers were sold and the remainder were wintered on pasture with some supplement in order to prepare them for the phase three cow herd. A summary of the data on the second calf crop to date follows:

Fifty-one straightbred cows weaned 45 calves (88%). Fifty-three crossbred cows weaned 49 calves (92%).

		Birth Weight	Feeder Grade at Weaning	Weaning Weight	Weight 12 May 70	No.
steers	straight	75	12.0	521	907	26
	cross	84	12.3	578	985	24
heifers	straight	72	11.5	483		19
	cross	73	12.3	518		25

The third calf crop of the "interim" phase was born in early 1970, and will be weaned in October. The cow herd (now pregnant with the ninth calf crop) will be transferred to the farm of a cooperating producer to complete the study of lifetime production.

Females for the phase three cow herd were purchased in October 1969. They will be assembled at the Shenandoah Valley Research Station in the fall of 1970, and bred in the 1971 breeding season.

V. FUTURE PLANS:

Phase three will proceed according to plan.

VI. PUBLICATIONS:

Gaines, J. A., G. B. Richardson, R. C. Carter and W. H. McClure. General combining ability and maternal effects in crossing British breeds of beef cattle. J. Animal Sci. (In press).

Also, one Research Report in 1969.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Virginia

Location		SVRS; SWRS; & Blbg.				
Breed of sire		Purebreds A; H; &S				
Breed of dam		Straightbreds & Crossbreds				
Line or group[1]		Straightbreds & Crossbreds				
Percent used in project		92				
Inventory as of July 1, 1970	Cows 2 years and over	99				
	Yearling heifers	130				
	Bulls and steers under 1 year	46				
	Heifers under 1 year	47				
	Bulls over 1 year	4				
	Steers over 1 year	44				
Repro. perf.	Percent pregnant[2]					
	Calf survival percent[3]					
Wean perf.	Adj. ADG[4]					
	Av. type sc.[5]					
Postweaning performance	No. of bulls					
	No. of heifers					
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments:

5 - Suggest S-10 scoring system; indicate if different.

BEEF CATTLE RESEARCH STATION
Front Royal, Virginia

I. PROJECT: CRIS Unit 03 30 019 313a 49

Breeding superior beef cattle for Virginia

II. OBJECTIVES:

To compare changes in performance and breeding values from two breeding systems: (a) single trait mass selection, and (b) the formation of intensely inbred lines for subsequent use in top and rotational crossing.

To evaluate selection criteria and procedures and to develop more precise and effective measures of quality and performance in beef cattle.

To simplify methods of individual, progeny, and sib testing so that the performance of breeding cattle can be evaluated at young ages.

III. PERSONNEL:

B. M. Priode, K. P. Bovard, R. C. Carter, P. A. Putnam, and W. T. Butts, Jr.

IV. ACCOMPLISHMENTS DURING THE YEAR:

1. Scope and nature of work undertaken.

During the past year, the development of inbred lines and single-trait selection lines was curtailed. Type selection lines in the Angus and Shorthorn breeds were discontinued. All genetic studies with Hereford cattle, inbred and type and growth selection, were terminated.

Emphasis was shifted from intense inbreeding to the crossing of inbred lines. Inbred Angus and Shorthorn lines, four lines for each breed, were put in a diallel crossing test, and the first linecross calves were born, spring 1970. The diallel test is expected to run for four years. Angus and Shorthorn growth selection lines were maintained without any changes in their management or prescribed numbers, so that it will be possible to compare the performance of linecross, inbred, and growth selection line calves. An, these performance data will be compared with the results of topcross tests at Blacksburg and at Mississippi that are being carried out with bulls from Front Royal lines.

A study of milk protein types will be made in cooperation with Dr. Charles A. Kiddy, Dairy Branch, Beltsville, Maryland. Milk samples were taken from cows in the herd this spring, and the samples will be typed for β-lactoglobulin, α_{s1}-casein, β-casein, and k-casein. Growth characteristics on the calves of the cows typed will be studied in relation to differences in milk protein. It may be possible to gain information on the tendency towards fixation of genes in inbred lines.

Several hundred blood samples were sent to Texas in connection with a cooperative study of blood antigens in the Front Royal cattle.

The reproductive development of 48 Angus heifers on record of performance test was studied. Weight, condition, pelvic and body measurements, ultrasonic measurements of fat, and estrous cycles will be related to later reproductive performance and ease of calving.

2. Research results.

Four years of calves' performance, 1965-68, were summarized for the 1970 Station Field Day. Data were collected from 403 Angus calves and 330 Shorthorn calves. Of these, 186 Angus and 138 Shorthorn were inbred. The remainder in each breed was about equally divided between the type and growth selection herds. Shown bebow are weight differences, inbred and type and growth selection calves, at 205 days, 365 days, and 18 months of age.

Breeding lines compared	Breed	Inbred lines Fd	Fc	Adj. 205-day weight	Weight difference - lb.* Heifer calves 365-day weight	18-mo. weight	Bull calves 365-day weight
Inbred vs. selection	Angus	.18	.29	34	43	46	88
	Shorthorn	.26	.37	48	65	82	100
Type vs. growth	Angus	-	-	32	56	72	87
	Shorthorn	-	-	21	14	18	89

*Differences are expressed as the advantage of selection lines over inbred, and growth selection lines over type selection

Four foundation lines contributed equal numbers to each growth selection lines, but the growth herds, as presently constituted, are dominated by one line in each breed, and by the descendants of a few of the original females. In the Angus growth herd, after 15 years of selection, 38 of the 49-cow herd trace to only 6 of 16 foundation daughters. Eleven females with an adjusted weaning ADG of 2.00 trace to one of Blcakwood Bandy's daughters, and this cow is solely responsible for the foundation sire's influence in the growth line. A similar situation exists in the Shorthorn growth herd where 12 females in the 1969 herd with an adjusted weaning ADG of 1.86 trace to one Sni-A-Bar Waverly foundation daughter.

At approximately one year of age, 12 of 25 non-inbred heifers were diagnosed puberal, compared with 2 of 23 inbred heifers. These diagnoses, along with pelvic measurements, were made as part of a study of reproductive development in Angus heifers.

V. FUTURE PLANS:

Under a supplement to the Front Royal breeding project, diallel crossing of Angus and Shorthorn inbred lines will be carried out for the next four years. Calves from these matings will be evaluated through postweaning feeding tests. The breeding value of linecross males and females will be tested. Angus and Shorthorn growth selection lines will be continued, as outlined in the original project. Supplementary studies, discussed above, of milk proteins, blood antigens, and reproductive development will be continued next year.

Top and rotational crossing of inbred and selection lines will be continued as planned. Angus bulls from these lines are being furnished to the Mississippi station and Shorthorn bulls to the Blacksburg (Virginia) station for cooperative studies.

Future studies will be oriented toward management, but the design of these studies will have to take into consideration the need to evaluate the performance of linecross cows, since this evaluation will require several years beyond the completion of the diallel. To a greater extent than in the past, future studies will involve cooperative work with other departments, will make more diversified use of Front Royal facilities, and will involve other species for research animals.

VI. PUBLICATIONS DURING THE YEAR:

McDaniel, Robert C., R. C. Carter, and W. T. Butts, Jr. 1969. Influence of condition on maternal performance of beef cows. J. Animal Sci. 28:133. (Abstr.).

Waugh, Gary A. and Thomas J. Marlowe.1969. Environmental influences on growth rate and grade of yearling beef cattle. J. Animal Sci. 29:541-546.

Krehbiel, E. V., R. C. Carter, K. P. Bovard, J. A. Gaines, and B. M. Priode. 1969. Effects of inbreeding and environment on fertility of beef cattle mating. J. Animal Sci. 24(4):528-533.

VII. PUBLICATIONS PLANNED:

Meacham, T. N., K. P. Bovard and B. M. Priode. 1969. Effects of supplemental vitamin A on the performance of beef cows and their calves. J. Animal Sci. (In press).

Bovard, K. P., J. P. Fontenot, and B. M. Priode. 1969. Accumulation and dissipation of heptachlor residues in fattening cattle.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Virginia

	Location	Front Royal	Front Royal	Front Royal	Front Royal	Front Royal
	Breed of sire	Angus	Angus	Angus	Angus	Angus
	Breed of dam	Angus	Angus	Angus	Angus	Angus
	Line or group[1]	A1	A2	A3	A4	A6
	Percent used in project	100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over	23	26	21	22	20
	Yearling heifers	6	9	3	5	14
	Bulls and steers under 1 year	3	3	1	2	9
	Heifers under 1 year	3	1	3	3	7
	Bulls over 1 year	2	3	2	4	2
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]	90	89	70	79	82
	Calf survival percent[3]	78	94	100	60	88
Wean perf.	Adj. ADG[4]	1.85	1.70	1.86	1.78	2.16
	Av. type sc.[5]	11.6	10.8	11.0	11.0	11.5
Postweaning performance	No. of bulls	3	4	3	3	4
	No. of heifers	6	9	3	5	14
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: age of dam, season of birth, sex, and creep feeding.

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Virginia

Location		Front Royal	Front Royal	Front Royal	Front Royal	Front Royal
Breed of sire		Angus	Angus	Angus	Angus	Hereford
Breed of dam		Angus	Angus	Angus	Angus	Hereford
Line or group[1]		A7	A8	A9	Total	H2
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over		28		140	
	Yearling heifers	11			48	7
	Bulls and steers under 1 year		14	17	49	
	Heifers under 1 year		13	14	44	
	Bulls over 1 year	1	2		16	
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]	88			84	88
	Calf survival percent[3]	91			86	87
Wean perf.	Adj. ADG[4]	2.06			1.96	1.32
	Av. type sc.[5]	12.8			11.7	10.0
Postweaning performance	No. of bulls	5		2[a]	24	
	No. of heifers	11			48	7
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks [a]Two bulls from outside breeders for ROP test						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments: age of dam, season of birth, sex, and creep feeding.

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Virginia

Location		Front Royal	Front Royal	Front Royal	Front Royal	Front Royal
Breed of sire		Hereford	Hereford	Hereford	Hereford	Hereford
Breed of dam		Hereford	Hereford	Hereford	Hereford	Hereford
Line or group[1]		H3	H4	H5	H6	H7
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over					
	Yearling heifers	12	1	10	13	15
	Bulls and steers under 1 year					
	Heifers under 1 year					
	Bulls over 1 year	1		1		
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]	100	74	85	84	70
	Calf survival percent[3]	89	64	94	97	97
Wean perf.	Adj. ADG[4]	1.90	1.54	1.72	1.79	1.67
	Av. type sc.[5]	10.9	10.5	11.6	11.4	11.7
Postweaning performance	No. of bulls					1
	No. of heifers	12	1	10	13	15
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: age of dam, season of birth, sex, and creep feeding.

5 - Suggest S-10 scoring system; indicate if different.

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Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Virginia

Location		Front Royal	Front Royal	Front Royal	Front Royal	Front Royal
Breed of sire		Hereford	Hereford	Hereford	Shorthorn	Shorthorn
Breed of dam		Hereford	Hereford	Hereford	Shorthorn	Shorthorn
Line or group[1]		H8	H9	Total	S1	S2
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over				19	22
	Yearling heifers			58	4	4
	Bulls and steers under 1 year				1	3
	Heifers under 1 year				3	2
	Bulls over 1 year			2	3	3
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]	82		82	60	55
	Calf survival percent[3]	97		92	75	82
Wean perf.	Adj. ADG[4]	1.94		1.75	1.79	1.87
	Av. type sc.[5]	11.9		11.3	10.7	10.7
Postweaning performance	No. of bulls	3	1[a]	5	3	3
	No. of heifers	8		66	4	4
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks [a]Bull on ROP test from outside breeder						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.

2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.

3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.

4 - Indicate adjustments: age of dam, season of birth, sex, and creep feeding.

5 - Suggest S-10 scoring system; indicate if different.

Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Virginia

Location		Front Royal	Front Royal	Front Royal	Front Royal	Front Royal
Breed of sire		Shorthorn	Shorthorn	Shorthorn	Shorthorn	Shorthorn
Breed of dam		Shorthorn	Shorthorn	Shorthorn	Shorthorn	Shorthorn
Line or group[1]		S4	S5	S7	S8	S9
Percent used in project		100	100	100	100	100
Inventory as of July 1, 1970	Cows 2 years and over	25	20		39	
	Yearling heifers	4	4	5	8	
	Bulls and steers under 1 year	4			12	13
	Heifers under 1 year	5			14	12
	Bulls over 1 year	3	3	2	3	
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]	84	61	50	82	
	Calf survival percent[3]	62	55	89	81	
Wean perf.	Adj. ADG[4]	1.66	1.58	1.75	2.08	
	Av. type sc.[5]	10.4	11.4	12.1	11.6	
Postweaning performance	No. of bulls	3	2	2	6	
	No. of heifers	4	4	5	8	
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: age of dam, season of birth, sex, and creep feeding.

5 - Suggest S-10 scoring system; indicate if different.

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Production, Inventory, and Performance Data, S-10 Herds - 1969-1970

State Virginia

Location		Front Royal	Front Royal	Front Royal		
Breed of sire		Shorthorn	Purebred	Various		
Breed of dam		Shorthorn	Purebred	Various		
Line or group[1]		Total	Herd Total	Crossbred		
Percent used in project		100	100	100		
Inventory as of July 1, 1970	Cows 2 years and over	125	265			
	Yearling heifers	29	135			
	Bulls and steers under 1 year	33	82	1		
	Heifers under 1 year	36	80			
	Bulls over 1 year	17	35			
	Steers over 1 year					
Repro. perf.	Percent pregnant[2]	66	78	100		
	Calf survival percent[3]	76	86	50		
Wean perf.	Adj. ADG[4]	1.86	1.85	1.70		
	Av. type sc.[5]	11.3	11.4	9.2		
Postweaning performance	No. of bulls	19	48			
	No. of heifers	29	143			
	No. of steers					
Slaughtered	No. of bulls					
	No. of heifers					
	No. of steers					
Remarks						

1 - Purebreds, grade, line, sire number, crosses, treatment, etc.
2 - Use palpation percent or percent of cows that gave birth to calves (dead and alive). If palpation record is used, do not include those pregnant cows that were disposed of before calving.
3 - Percent of calves born (dead and alive) that survived to weaning. The product of percent pregnant and survival percent gives weaning percent.
4 - Indicate adjustments: age of dam, season of birth, sex, and creep feeding.

5 - Suggest S-10 scoring system; indicate if different.

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